SARGENTIA

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VIII

THE BOTANY OF SAN JOSE ISLAND
(GULF OF PANAMA)

BY

I. M. JOHNSTON

WITH SEVENTEEN PLATES AND
TWO TEXT-FIGURES

PUBLISHED BY

THE ARNOLD ARBORETUM OF HARVARD UNIVERSITY

JAMAICA PLAIN, MASS., U. S. A.

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SARGENTIA

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PREFACE

THE PRESENT PAPER is a detailed discussion of the vegetation and flora of a small island off the Pacific end of the Panama Canal. The island is not one which would ordinarily attract particular botanical attention. Its flora is much like that at the Pacific end of the Canal Zone, while its vegetation is notable only for having remained very long undisturbed. During the recent war, however, it was leased by the United States Army, and its vegetation, as an integral part of its environment, became of interest when a tropical testing ground for the Chemical Corps was established there. As a botanist I was invited to the island and given every facility for exploration and study. This paper gives an account of my findings.

In presenting my data I have had in mind not just the professional botanist. I have tried to make my report intelligible to the Army personnel who work in the forests of the island and also to the ordinary visitor who is interested in the plants and various other objects of tropical natural history study which he may meet with there. Botanical verbiage has been used as little as possible. Though much technical matter, interesting only to botanists, has been included, it has always been segregated in paragraphs and may be skipped by the general reader. In discussions I have tried to be interpretative as well as factual. Most of the persons stationed on the island or visiting there come from the United States. One of my purposes has been to supply these persons with information that can give interest and meaning to the unfamiliar tropical plant life which they find on San Jose Island.

Many people have helped me during my work on the botany of San Jose Island. My association with the Chemical Corps (previous to 1946 known as the Chemical Warfare Service) has been one that I shall remember with pleasure. I was treated most kindly, was given every help, and enjoyed the friendship of the very fine group of officers and men in that service. To Major General William N. Porter, and later Major General Alden H. Waitt, Chief of the Chemical Corps, and to Colonel Lowel E. Elliott, Deputy Chief, as well as to those directly connected with the San Jose Project, Brigadier General E. F. Bullene, Colonel R. D. McLeod, Jr., Colonel Donald W. Leavens, Colonel Adrian St. John, Colonel Thomas G. Thompson, and Major William W. Campbell, I am particularly indebted for the many privileges and for the unusually fine opportunities for botanical work given me. Major Campbell continued his many kindnesses even after I left the island. He collected personally special material needed in my studies, and furthermore has been most generous with helpful advice and in obtaining data for the preparation of this report.

During work on the report at the Arnold Arboretum I have had assistance from a number of my botanical colleagues. Dr. Eric Hultén, Director of the botanical section of the Naturhistoriska Riksmuseet, Stockholm, obtained transcripts from the log of the "Eugenie" and loaned me specimens collected during the visit of the frigate at San Jose in 1852. Loans of critical specimens needed for comparison were received from the United States National Museum and from the Chicago Museum of Natural History through the

courtesy of E. P. Killip and Paul C. Standley. Expert help in the identifying of certain groups of plants has been received from Caroline K. Allen (Lauraceae), Paul H. Allen (Orchidaceae), Agnes Chase (Gramineae), Ian D. Clement (*Sida*), Arthur Cronquist (Sapotaceae), R. C. Foster (*Cuphea, Marsdenia*), H. A. Gleason (Melastomaceae), C. E. Kobuski (Theaceae), H. N. Moldenke (*Abuta*), C. V. Morton (*Smilax, Cestrum*), Bernice G. Schubert (*Desmodium, Begonia*), Charles Schweinfurth (Orchidaceae), A. C. Smith (Hippocrateaceae), H. K. Svenson (Cyperaceae), L. O. Williams (Orchidaceae), T. G. Yuncker (Piperaceae). For all their help I am most grateful.

THE BOTANY OF SAN JOSE ISLAND

I. M. Johnston

with seventeen plates and two text-figures

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PHYSICAL FEATURES AND HISTORY OF SAN JOSE ISLAND

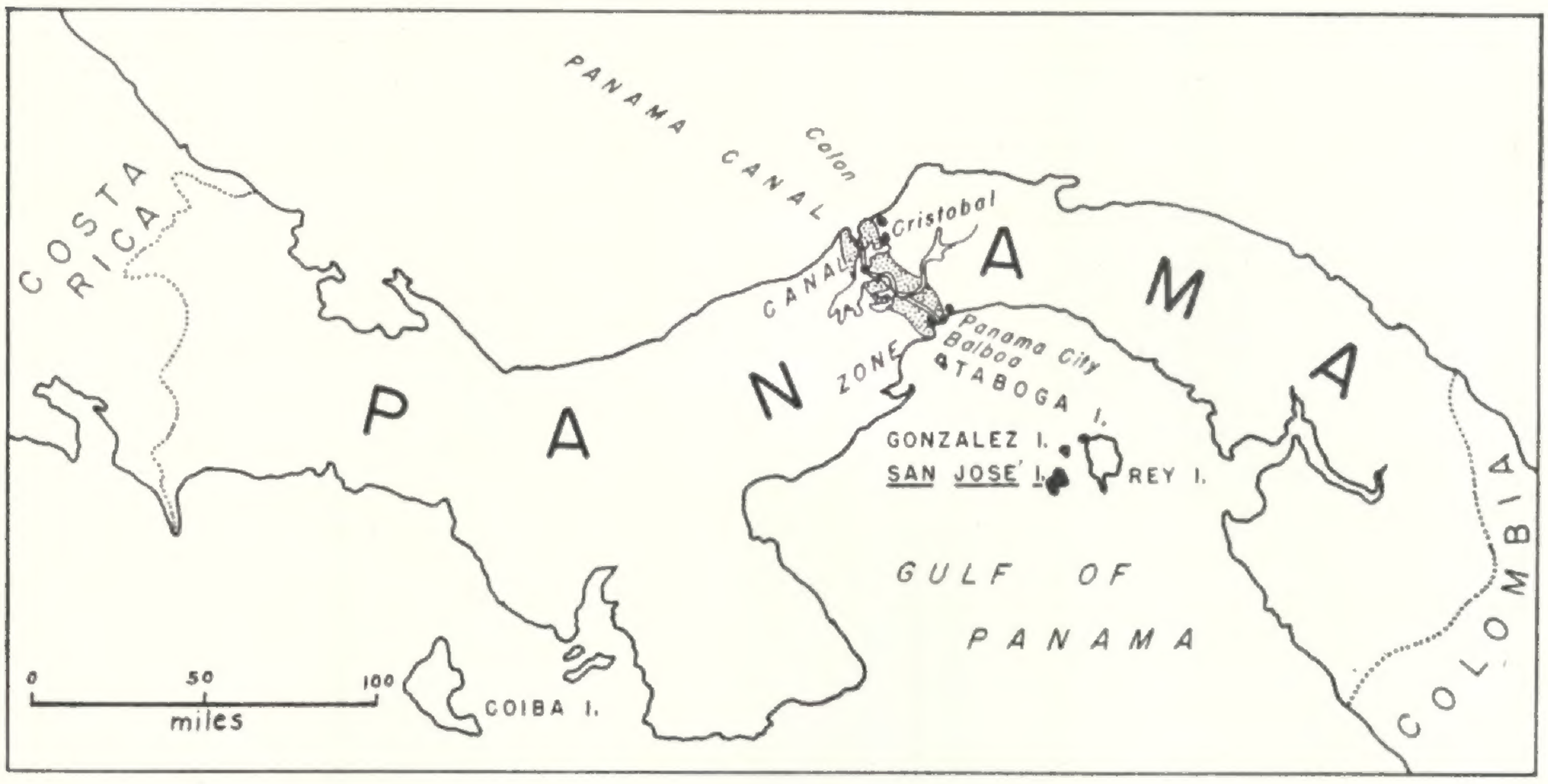
San Jose Island is the second largest and the most southerly and westerly of the Perlas Islands and lies near the center of the Gulf of Panama, about forty miles off shore to the south of Panama City. It is very irregular in outline, and furthermore, constricted as it is to about a mile and a half in width south of its middle, is roughly divided into two unequal halves. Although the main axis north and south is about eight miles and the east

to west span about five miles, the island has an area of only some fifteen square miles. Geologically it is composed of bedded and consolidated sedimentary rocks of volcanic origin, apparently Oligocene in age, which have been faulted and much cut by dikes and sills of andesite and basalt. Along with the other Perlas Islands it was probably part of the mainland during early Pleiocene time and is now seated on the submerged continental shelf and surrounded by waters of no great depth. The island is generally hilly but at many places has flat-topped ridges and level areas. These areas frequently result from horizontal bedding of rock, but in some instances seem best explained as the result of some previous period of peneplanation. The elevations of San Jose over its southern two-thirds are mostly below two hundred feet. In its northern third, however, the island builds up and has considerable surface in excess of three hundred feet elevation. Here is found the highest point on San Jose, said to be about 450 feet in altitude and located on the ridge northeast of the junction of Bald Hill Road and the Loop. There are many perennial streams. Most of these run in ravines or V-shaped valleys, but some, especially those in the middle third of the island, are only shallowly trenched. The streams usually flow in boulder-strewn, rocky beds and generally accumulate very little sand or mud along their length. No lakes or ponds occur on the islands, and the only swamps are coastal ones developed at the mouth of some of the larger streams. A beautiful curved length of strand occurs at Playa Grande, but elsewhere on the coast sandy beaches are generally small and scattered, and are really well developed only in Bodega Bay. The shoreline of the island is prevailingly rough and rocky. Most of it consists of sea cliffs rising from the surf commonly twenty to fifty feet but in places even to a hundred feet in height.

The climate of San Jose, like that along much of the Pacific coast of Central America, is marked by a periodic alternation of wet and dry seasons. The annual precipitation on San Jose averages between eighty-five and ninety-nine inches. Usually two-thirds of this falls during the four months August, September, October, and November. The dry season prevails from mid-December through April. A few inches in scattered showers may fall during the first and last of this period, but January, February, and March are usually completely rainless. Showers may be expected in May, but the first good rains come in June. Temperature extremes of sixty-seven and ninety degrees have been recorded on the island, but the average monthly mean varies between seventy-six and eighty degrees. The relative humidity averages about 85 per cent. During the dry season it may range between midday and midnight from 70 per cent to 91 per cent, but in the wet season usually only from 82 per cent to 90 per cent. As with the temperature, its greatest diurnal range is shown during the dry season. During most of the year the island receives rather steady winds from the north. Only during the rainiest months are its winds rather variable, and only then are a large percentage of them from the southern quarter. The climate of San Jose is rather similar to that of Balboa at the Pacific end of the Panama Canal. It differs, however, in having about 30 inches greater annual precipitation and a usually completely rainless dry season.

Previous to 1944, San Jose Island is known to have remained uninhabited for about eighty years. During the past century two visitors so reported it. In 1852 the Swedish exploring frigate "Eugenie" came to the island for water

and fuel and anchored for several days just north of the large sugarloaf rock on the northeast coast. C. Skogman, Fregatten Eugenies Resa **1:** 159–163 (1854), in his account of the visit, states that the island was uninhabited, but reports that a dilapidated thatched hut and some cattle were seen there. In 1882, thirty years later, Carl Bovallius also visited the northeastern coast and made excursions inland. In his account, Ymer **6:** 13–14 (1886), he reported seeing no dwellings nor cattle on San Jose. Since he was especially interested in the Perlas Islands and had visited most of them, including the inhabited Gonzales Island adjoining San Jose, it can be believed that he had information backing up his explicit statement that the island was then uninhabited.



Map of Panama showing the location of San Jose Island. The island lies on the Pacific side of the Isthmus near the center of the Gulf of Panama.

According to the present owner of the island it was last inhabited in the late 1850's. At that time San Jose was bought by an Englishman, who cleared some land, introduced cattle, and established residence on the island, only to be murdered within a few months. A few dishes and a spoon unearthed on a bank at the west end of Englishman Beach probably marked the site of the home of this unfortunate last settler. Some giant balsas dominating the near-by forest may be monuments situated on his former clearings. A search of the island has produced no other mementos of a permanent settlement there. A special search was made for old fruit trees, especially mangoes, which might have persisted in the forest as markers of former sites of habitation. They were found only at Mango Beach. The mango, calabash, and banana plants found there, however, probably only mark an old watering place and *pied-à-terre* of fishermen or pearl divers, and not a permanent settlement. Since the murders on the island, it has been traditional to attribute the neglect of San Jose to superstition. Natives of the other Perlas Islands are said to believe the island haunted and to shun it after dark. Special conditions on San Jose, however, may make it an uninviting place for the types of agriculture practiced in the region. It seems more likely that economics, rather than superstition, has caused it to

remain unused by man. In any case nature was allowed to reign supreme on San Jose for a considerable period. We can say with certainty that by 1944 San Jose had a vegetation which had developed, free of the influence of man, over a period of eighty years. For the greater part of the island, however, this is obviously a minimum figure. Only a relatively small area was disturbed by the last settler. By 1944 most of the vegetation on San Jose must have represented uninhibited growth for at least a century and probably even longer.

In 1943 neglected San Jose felt the impact of the World War. Late that year a station was established by the Navy on the southwest corner of the island. This consisted of a small clearing and a few buildings located at the summit of a great sea cliff and was serviced by a road chopped through the forest from Navy Cove. Operations there, however, were very localized, and the serenity of the island remained undisturbed. This was short-lived. The U. S. Army had selected San Jose as a tropical testing ground for the Chemical Corps, then known as the Chemical Warfare Service. The engineers in charge of installations landed at Main Beach in Bodega Bay in January 1944, and within six months roads had been put through to all parts of the island, camps were established, a large army personnel was in residence, and tests were in progress. The island, after years of neglect, became the center of great activity. Its parts, formerly difficult of access, had been abruptly opened to exploration by a host of trails and an excellent system of roads. A vegetation that had developed undisturbed over a long period was suddenly exposed and made accessible for study.

At that time San Jose was practically unknown botanically. A small collection of plants had been made on the northeastern coast during April 1852 by N. J. Andersson, botanist on the "Eugenie." This, however, was never studied nor listed, and most of it still remains unidentified in the museum at Stockholm. Some mention of the vegetation of San Jose is to be found in the published accounts of visitors to the island, but this can be dismissed as more literary than botanical, and not only very sketchy but generally inaccurate. As the Chemical Corps proceeded with tests at San Jose, a need for general information regarding the local flora and vegetation was recognized. As a result I was sent to the island by Division 10 of the Office of Scientific Research and Development, as Special Adviser, and remained there from September 29 to November 16, 1944. This was the first of three visits to San Jose. Two others, under the auspices of the Chemical Corps, covered periods from March 22 to May 2, 1945, and from December 22, 1945 to February 19, 1946. Botanical work, in addition to my own, was also carried on at San Jose by C. O. Erlanson of the U. S. Department of Agriculture, who was in residence on the island from early April to mid-August, 1945. Erlanson collected the flora during the close of the dry season and through the early part of the wet season, and his specimens provide valued supplementary data to that accumulated during a total of about five months (153 days) which I spent in tramping over the island, collecting and studying the vegetation.

As a result of the Army activities, San Jose in a short time has been transformed from an island shunned and uninhabited—a mere spot on the map—into one of the most intensively studied areas in Central America, and one with a name that will appear frequently in scientific literature. In addi-

tion to botanical work, intensive zoological exploration was also carried on at San Jose during war years. A series of papers on the fauna of the island, and also a short report by C. O. Erlanson on the vegetation of the island, have already been published by the Smithsonian Institution, Miscellaneous Collections, vol. 106, nos. 1–7 (1946). Several other accounts of the island, to be published elsewhere, are in preparation. Meteorological data from the island has appeared in reports from the Canal Zone.

GENERAL CHARACTERISTICS OF THE SAN JOSE FLORA

San Jose Island has a Panamanian flora. Most of the species of plants on the island are known to grow on the Pacific slope of western and middle Panama, and very probably all of them will be found there eventually. Some of the San Jose Island plants are restricted to Panama or to Panama and western Costa Rica, but the majority range widely at low altitudes in those parts of the American tropics which have a pronounced wet and dry season, particularly in southeastern Mexico and western Central America, in Yucatan, British Honduras, and eastern Guatemala, in northern Colombia and Venezuela, and in parts of the West Indies.

Facts regarding the relationships of the San Jose flora may be brought out by a comparison of the species it shares with well-explored Barro Colorado Island. The latter, located in Gatun Lake, is a third the size of San Jose but is known to have 1060 species of flowering plants. San Jose has about 630 species, about 450 of which are also known from the Canal Zone. Of the approximately two thousand species reported from the Canal Zone, half are represented on Barro Colorado and less than a fourth on San Jose. The two islands share only 280 species, about one-seventh of the total Canal Zone flora. Barro Colorado has the dense high forests of the wet Atlantic slopes of the Zone and the distinctive species and richness of flora of that vegetation. The small fraction of Zone species shared by Barro Colorado and San Jose, a fraction which could be further diminished if widespread tropical weeds were removed from consideration, is clear indication that our islands' mutual share in the total flora of the Canal Zone must be of species living in parts of the Zone away from the Atlantic Slope. The species of the Canal Zone that occur also on San Jose are, in fact, mostly inhabitants of the seasonally dry Pacific lowlands about the southern end of the Zone.

By plant geographers the vegetation of San Jose would be classed as an insular aspect of that dominating the dry lowlands of the Pacific slope of Costa Rica and western and middle Panama. The common species of the island are present on the adjacent mainland. Present there also are types of forest and grassland essentially similar to those on the island. Many species and some types of vegetation present on the mainland, however, are not found on San Jose. As is frequently the case with insular floras, the number of species on San Jose is lower than might be expected in an area of comparable size and diversity on the mainland. Many characteristic trees and shrubs, common and well known along most of the Pacific slope of Costa Rica and western and middle Panama, are absent from San Jose. Notable among these are *Triplaris americana* (Guayabo hormigero), *Licania arborea*, *Enterolobium cyclocarpum* (Ear Tree), *Acacia costaricensis* (Bull-horn Acacia), *Pithecollobium Saman* (Rain Tree), *Hura crepitans* (Sand-box Tree),

Bombax Barrigon (Barrigon); *Cavanillesia platanifolia* (Cuipo), *Sterculia apetala* (Panama Tree), *Bixa Orellana*, and *Tabebuia Guayacan* (Guayacan).

The plant-cover on San Jose Island is not a rich and lush tropical vegetation. To a visitor from the United States the forests of the islands may seem high and dense, but compared with the giant wet tropical forests that develop where rain falls every month of the year the forests of San Jose are only moderately high and the individual trees generally small and slender-trunked. Compared with wetter tropical regions, this island has only a scanty representation of palms, ferns, and aroids. Tree ferns are conspicuously absent. Epiphytes, those plants, such as orchids, which habitually grow on tree trunks and branches, so abundant in number and variety in the wet forests, are poorly developed here. The concentration of species on the island is not high. An area of comparable size and topography in the wet tropics would have several times the number of species found on San Jose. The vegetation of San Jose Island is characteristic of the drier tropics, vigorous, but periodically curbed by an annual dry season.

TYPES OF NATURAL VEGETATION

The vegetation of the island is composed of a number of distinctive plant associations. These differ in composition and aspect. For convenience they may be grouped and discussed under the following headings:

1. Grassland
2. Thicket
3. North Forest
4. South Forest
5. Marino Forest
6. Deciduous Forest and other vegetation on thin soils
7. Streamside Forest
8. Coastal-Swamp Forest
9. Beach Vegetation

GRASSLAND

There is one area of well-developed grassland on the island, the so-called "Bald Spot" on Bald Hill (PLATE 4). The only other grassy areas of any size are the relatively very much smaller ones associated with deciduous trees and shrubs on thin soil at East Harbor (PLATE 3). These latter, however, represent simply large congregations of the particular grasses, sedges, and other herbs that frequent the thin soil on islets, ledges, and clifftops along the coast. Very different in composition from the Bald Hill grassland, they are best treated as part of the vegetation of thin soils, which will be discussed later.

The grassland at Bald Hill is surrounded by forest. It occupies a roughly triangular area of about twenty acres located astride a broad high ridge towards the northern end of the island. The soil here differs in no obvious way from that found in other parts of the island. Topographically, the site is not unusual. There are other ridges in the vicinity which are similar in orientation, slope, and exposure. They, however, are clothed in forest. There seems nothing in site nor in soils to account for the localized development of grassland at Bald Hill.

There are no indications that any part of the Bald Spot has ever been used for agriculture. It has not, however, been completely undisturbed. Natives of the near-by Perlas Islands have visited it annually because of the abun-

dance of iguanas congregating there during the breeding season. It may have been frequently burned. In any case, it had been burnt over when the first of the Army personnel visited it in early 1944. The vegetation at Bald Hill was not formed as a result of human activities, nor has it persisted because of them. Its general composition and component species show it to be a natural grassland of the type found in many parts of tropical America. For obscure reasons it is present and able to maintain itself in this particular locality on San Jose. Perhaps it may have originated in a past period when, under prevailingly drier climatic conditions, grasslands were more widely developed in the Panamanian region than they are today. Possibly it is just the persisting remnant of a larger grassland present on the island during an earlier, drier climatic period.

Whatever its history may be, the grassland dominates its terrain today. By 1946 it was very evident that the grassland flora would reclaim those areas on the Bald Spot which road-making bulldozers had disturbed and cleared two years previously. Only a few stunted individuals of the usually fast-growing weed trees *Trema* and *Ochroma* had become established along roads over the grassland by 1946. At roadsides in the forest, however, these weed trees were present in incredible numbers and had grown to large size. Observations at the boundary, where grassland gave way to forest, were also significant. Even where new roads crossed this boundary, tree species showed no signs of encroaching on the grassland. The reverse, however, is not true. By 1946 a colony of grassland plants had become well established and dominant along a shallow cut at the roadside over a hundred yards north of the Bald Spot and in an area formerly covered by open forest.

The dominant grasses at Bald Hill are *Trachypogon secundus* and *Axonopus aureus*, with the coarse, bristly *Panicum Rudgei* the most conspicuous of the secondary ones. These are rather coarse bunch grasses, growing 3–15 dm. tall. On some limited areas growth may be rank and dense, but over the larger part of the area the clumps are loosely spaced, and passage between them is not difficult. Growing between the clumps of the dominant grasses are a variety of flowering herbs, some sedges, and a goodly number of annual grasses. Some of these, like the diminutive *Borreria pumilio* or the delicate *Curtia tenella*, grow only on the more elevated places and on the steeper slopes where the grass clumps are more scattered. The greatest variety and abundance of small herbs, however, occurs in more nearly level and generally more moist areas of the grassland towards the fringe of the forest. *Curatella americana*, a small gnarled tree which grows scattered in many tropical American grasslands, is present in limited numbers over the western portions of the Bald Spot. Except for a single individual of *Andira inermis*, isolated on the highest point of the ridge, these are the only trees to be found in the grassland proper.

The herbaceous plants found in the Bald Hill grassland are listed below. Those starred were not seen elsewhere on the island.

Andropogon bicornis
Andropogon brevifolius
**Andropogon leucostachyus*
**Aristida capillacea*
**Axonopus aureus*
**Axonopus centralis*
Oplismenus Burmanni
Panicum Rudgei
Paspalum multicaule
Paspalum plicatulum

Setaria tenax
**Trachypogon secundus*
**Bulbostylis junciformis*
Cyperus flavus
**Dichromena ciliata*, forma
Kyllingia odorata
Scleria micrococca
Scleria pterota
**Curculigo scorzoneraefolia*
Dioscorea sapindoides
Habenaria pauciflora
**Spiranthes orchioides*
Aeschynomene brasiliana
Calopogonium mucunoides
Centrosema pubescens
Clitoria rubiginosa
**Crotalaria pilosa*
Desmodium angustifolium
Desmodium barbatum
Phaseolus longipedunculatus
**Euphorbia hyssopifolia*
Sida linifolia
**Sida spinosa*
Waltheria americana
Sauvagesia tenella
Pterolepis pumila
Coutoubea spicata
**Curtia tenella*
Blepharodon mucronulatum
Ipomoea minutiflora
**Hyptis lantanifolia*
Borreria latifolia
Borreria parviflora
**Borreria pumilio*
**Elephantopus mollis*
Eleutheranthera ruderalis

Few of the grasses and other herbs common and widely distributed on other parts of San Jose are present in the grassland. Those species found at the Bald Spot but not confined there are mostly shared with areas of thin soil near the coast; in a surprising number of cases only with the area of thin soil at East Harbor. Some of the trees associated with the grassland and its margins also show this behavior. The explanation probably lies in the fact that we are dealing with plants demanding sunny open situations uncrowded by large trees, a condition best developed at Bald Hill and on thin soil areas along the coast.

The fringe of the forest that surrounds the Bald Hill grassland is rather distinctive and indicative of the special conditions there. Vines which drape forest margins heavily in other parts of the island are here almost lacking. Some widely distributed trees on the island, such as *Byrsonima crassifolia*, *Spondias Mombin*, *Apeiba Tibourbou*, *Vismia ferruginea*, *Miconia minutiflora*, and *Cordia panamensis*, are unusually numerous in the forest fringe. *Cochliospermum vitifolium*, *Myrcia tomentosa*, *Psidium guineense*, and *Guettarda odorata*, generally confined to thin soils, particularly near the coast, are surprisingly common. *Xylopia aromatica*, rare elsewhere on the island, is very common at the forest margin on Bald Hill. *Clidemia rubra*, *Miconia albicans*, and *Cornutia grandifolia* have been found at no other place on the island.

The Bald Spot on San Jose is a characteristic bit of tropical grassland or savanna. The species growing there are widely distributed in tropical America and are present in essentially the same association in the natural grassland of the Panamanian savannas; and, interestingly, most of them are also present on the grassy treeless summit of Ancon Hill near Balboa. Grasslands are present on other Perlas Islands and are widely distributed and well-known features in the drier tropics and are sometimes of vast extent, as in Venezuela and Brazil. Forests and grasslands of types very similar to those on San Jose are common and juxtaposed on the Pacific slope of Panama. Although there has been a prevalent notion on San Jose that the Bald Spot was somehow unusual and in need of special explanation, it is

in no way remarkable. San Jose shares its climate and flora with the Pacific slope of Panama. Since forests similar to those on the isthmus are present on the island, it should be no cause for surprise that another type of vegetation, the grassland, is shared with the isthmus also.

THICKET

Extremely dense growths of shrubs and bushy trees prevail over large areas on the island. Among the Perlas Islands only San Jose has these great thickets. The island owes much of its distinctive landscape to them, and they constitute an interesting and very important type of vegetation. Though most extensive on slopes near the coast, especially on the west side, they are not confined to these situations. Various large areas of thicket occur in the central parts of the island and many patches of it are found isolated in the forests that prevail there. Thickets are widely distributed near the coast and in the interior, on level areas as well as on slopes of varying steepness and differing exposure. They are not correlated with any obvious peculiarities of soil.

The thickets are not homogeneous. They vary much in height, composition, and general aspect. Two types of growth are mixed in them. One forms a low grayish green thicket 1.5–2.5 m. tall, composed of slender-stemmed shrubs such as *Callicarpa acuminata*, *Cordia ferruginea*, *Solanum extensum*, and *Calea prunifolia*. The other forms a high green thicket of bushy trees, generally 3–4.5 m. tall, made up of species which may also appear as canopy trees in the forest. These two types of growth may be present in pure stands, but are usually mixed in varying proportions. The growth they form is very dense, and furthermore is well laced together by an abundance of vines. It is penetrable only by determined, lusty, and continuous use of the machete. A few kinds of tall-growing plants are usually to be found emerging from the thicket. Lifting their tops here and there above the stretches of dense lower vegetation, they give variety to what otherwise would be a monotonous landscape. One of them is *Gynerium*, the Giant Cane, very abundant in the gray thickets near Camp. Most characteristic of thickets, however, are the tall, widely scattered, emergent trees of *Cordia alliodora*, *Zuelania Guidonia*, *Tabebuia pentaphylla*, and especially *Cecropia*.

The common and characteristic plants of the two types of thicket may be listed as follows:

LOW GRAY THICKET

Principal shrubs:

Callicarpa acuminata
Cordia ferruginea
Solanum extensum
Calea prunifolia

Emergent trees:

Cecropia arachnoidea
Zuelania Guidonia
Cordia alliodora
Tabebuia pentaphylla

Secondary shrubs:

Gynerium sagittatum
Dalbergia Brownei
Hibiscus tiliaceus
Lycoseris latifolia

Common vines:

Serjania atrolineata
Davilla lucida
Tetracera volubilis
Anemopaegma orbiculatum
Amphilophium paniculatum
Arrabidaea Chica
Phryganocydia corymbosa

HIGH GREEN THICKET

Principal trees:

Cecropia arachnoidea
Xylopia frutescens
Nectandra Gentlei
Phoebe Johnstonii
Hirtella americana
Pithecollobium rufescens
Protium McLeodii
Zuelania Guidonia
Cordia bicolor
Cordia alliodora

Secondary trees:

Ficus Standleyana
Cupania fulvida
Casearia myriantha
Casearia sylvestris
Hasseltia floribunda
Miconia argentea
Miconia hyperprasina
Miconia insularis
Miconia impetiolaris
Miconia pteropoda
Didymopanax Morototoni
Cordia panamensis
Isertia Haenkeana

Common vines:

Philodendron Erlansonii
Connarus panamensis
Cnestidium rufescens
Bauhinia Thompsoniana
Dioclea megacarpa
Dioclea reflexa
Machaerium purpurescens
Clitoria portobellensis
Serjania atrolineata
Serjania nesites
Hippocratea volubilis
Hiraea reclinata
Gouania polygama
Cissus rhombifolia
Cissus erosa
Davilla lucida
Tetracera volubilis
Anemopaegma orbiculatum
Amphilophium paniculatum
Phryganocydia corymbosa
Chiococca alba

The thickets of San Jose, though conspicuous and extensive and constituting an obvious type of vegetation, cannot be sharply delimited. Where areas of thicket meet grassland and most kinds of forest the boundaries are usually abruptly drawn. This, however, is not the case with Thicket and North Forest. These are not distinct but rather connected through many subtle stages of transition by intermediate types of vegetation, sharing in varying proportion the distinctive characters of the two extremes. The principal stages by which thicket passes over gradually into forest can be described in a few words. The Low Gray Thicket is one extreme. This is composed of bushes with generally thin stems. It forms a dense growth, usually 1.5–2.5 m. tall, out of which emerge scattered trees of *Cecropia*. In places tall-growing trees such as *Cordia alliodora*, *Zuelania Guidonia*, and *Tabebuia pentaphylla* have been able to get a start and have joined the *Cecropia* here and there in lifting their crowns high above the low vegetation. The low-growing, slender-stemmed, gray-green bushes may dominate over large areas, but they are commonly mixed in varying proportions with bushy green-leaved trees characteristic of the High Thicket. These latter mostly belong to species that are also present in the North Forest, where they grow to large size and have their tops in the forest canopy. In the thicket, however, they are bushy in growth and form large coarse woody shrubs. These green-leaved bushy trees, by increasing in number and size, can give the thicket an uneven top. Where they predominate and largely replace the lower gray thicket growth, they can raise its prevailing height to 3–4.5 m. Where the bushy trees in High Green Thicket reach good size, crowding and competition for sunlight accentuate their upward growth. Their crowns be-

come more and more elevated, and they change from a bushy to an increasingly arboreal form. Where arboreal growth of this sort prevails and only small scattered interspersed areas of bushy growth remain, the vegetation has become representative of one phase of the North Forest type.. Thickets illustrative of all the transitional stages described are common and widely distributed on the island, especially so on its northern half.

The various phases of the thicket and the stages by which it appears to pass over into forest, as just described, are exactly what are to be expected if the San Jose Thicket is normal second-growth vegetation. The Low Thicket might be the early type of vegetation that develops on land cleared of forest. Developing, it would produce an environment in which the slower growing bushy trees of the High Thicket could get their start. With the passage of time these bushy trees would come to dominate, and later, because of crowding, they would slowly assume arboreal form and the thicket would eventually become true forest. It is generally agreed that one hundred years is sufficient for the regeneration of a high tropical forest by normal undisturbed second growth. The moderately high forests of San Jose should redevelop on cleared land in fifty to seventy-five years. As second growth, i. e. vegetational phases in the regeneration of forest on land formerly cleared, the San Jose Thicket would be a transient type of growth, and its successive phases would each have a definite setting in time. The thickets on the island seem to have the appearance of second growth. However, only if they also have the proper history can they be correctly identified as representing that type of vegetation.

If San Jose Thicket is accepted as ordinary second growth, several things are necessarily implied. The land it occupies must have been cleared of forest during the past century. This might have resulted from human activities or from some natural catastrophe such as severe drought or violent hurricane, followed perhaps by fire. These destructive agencies would have had to operate in all parts of the island, near the coast and in the interior, as well as on flats and on sloping terrains with all types of exposure. They would have had to operate within the last hundred years. With the High Thicket representing the older, most advanced stages of second growth, that which has been developing over the longest period of time, all the large areas on the island with this type of vegetation must needs have been cleared and made available for the start of forest regeneration about the year 1875 or later. Low Thicket, if a younger, less developed stage of second growth, would indicate, correspondingly, that other areas became available for reforestation in much more recent times. In fact, since all the subtle transitions between Low Thicket and North Forest exist, areas in all parts of the island must necessarily have become available for the start of second growth, bit by bit, during the whole of the past seventy-five years or more. These implications are counter to historical fact. The past seventy-five years represent the very period in which the island is known to have lacked permanent settlement, and during which, because of the belief that it was haunted, it was seldom visited by natives of the near-by islands. The vast tracts of thicket on San Jose cannot represent land cleared for agriculture during that period! A natural catastrophe such as a hurricane or drought, severe enough to devastate forests on all the large and topographically diverse sections of

the island now dominated by thicket, would be a first-rate historical event. No calamity of this magnitude is included in the past century of local history.

Despite its resemblances, San Jose Thicket cannot be ordinary second growth. Certainly the greater part of the land it occupies on San Jose has not been disturbed during the past century. During such an interval normal second growth should have completed its transformation into forest. Although thickets are bountifully present on San Jose, vegetation of that type and abundance is not present on the other near-by islands of the Perlas group. The island of Pedro Gonzales, only a few miles from San Jose, has been continuously inhabited for many years, certainly for well over a century. Continuously there land has been cleared of forest, used for a time, then abandoned. Though forests of the kinds found on San Jose are present there, thickets such as those on San Jose have not developed. If San Jose Thicket is normal second growth, it should be present also on Gonzales. Certainly Man has been a continuous influence there, and certainly no drought nor hurricane that could devastate half of San Jose could leave near-by Gonzales entirely unscathed. The behavior of new vegetation that has volunteered on clearings made on San Jose since early 1944 is also significant. Away from roads, where ditching has not modified drainage, clearings in thickets left undisturbed for two years first produce abundant grass and saw-grass (chiefly *Lasiacis oaxacensis* and *Scleria secans*). A few short-lived fast-growing trees appear, but most of the woody growth belongs to species previously growing in the area. There is every indication that land cleared of thicket would be reclaimed by it if undisturbed for less than ten years. Clearings made in the forested parts of San Jose do not produce Thicket. They quickly produce grasses and saw-grass, various short-lived fast-growing trees (such as *Trema, Ochroma, Apeiba, Erythroxylum*, etc.) and numerous seedlings of the species represented in the former forest. In a few years the fast-growing trees should form a temporary canopy that will be replaced eventually by the slower growing, longer-lived trees of the original forest. The forests are replaced by normal second growth, the kind observed on Gonzales. It is a type of vegetation different from that represented by the San Jose Thicket.

If San Jose Thicket is not transient second growth, it must be a more enduring plant formation. It must be the most luxuriant vegetation which the terrain it occupies can produce. This is unusual, since most parts of the tropics can support forest. The other Perlas Islands can do so, but apparently half of the area on San Jose cannot. Possibly something in the local environment may limit vegetation there to bushy growth—perhaps one of the factors usually operative in such cases, namely, adverse exposures, limited water supply, or poor soils. Thicket shows absolutely no correlation with any particular type of exposure. Like the forest with which it shares the island, it occurs near the coast and in the interior and on flats as well as on slopes of various exposures.

Similarly, the distribution of Thicket seems unrelated to deficiencies in soil moisture. The soils in thicket areas do seem to become generally drier during the rainless months than soils in the ordinary forests of the island. Seasonal aridity, however, is no bar to forests in the tropics. This is well illustrated by the Deciduous Forest which on San Jose develops on thin soils covering bed rock. The soil in that type of forest becomes very much drier

than that in thicket areas. During the dry season it is as parched as any desert, but it still supports a forest. Evergreen and deciduous forests of the type and composition present on San Jose are also present on near-by Pedro Gonzales. If one insists that soils on San Jose cannot support forest because they are well drained, one must be prepared to explain why this is not also the case on Gonzales. There certainly must be some large areas of well-drained soils there, yet no thickets have developed on that neighboring island.

We have seen that the peculiar San Jose Thicket is not correlated with special slope exposures nor with deficiencies in soil moisture. The possibility that this vegetation may be associated with peculiarities of soil chemistry or soil structure must also be considered. On topographically similar situations the soils from areas of thicket and forest seem very much alike. Both tend to be shallow. The top layer of humus is generally thin in both. Unfortunately there are no comparative soil analyses available. Accordingly, there must remain the possibility that despite superficial similarity they may differ chemically. Deficiencies of essential components in the soils of thicket areas, or the excess of deleterious ones, may be the factor which limits that land to its special type of vegetation. If the soil of thicket areas is poorer in quality than in the forested parts of San Jose, it can be the result of weathering of special rock strata or of excessive depletion following some critical event in its history. Geology gives no explanation. Special strata which by weathering could produce a peculiar soil are not to be expected on the island. Geological reconnaissance indicates that the structure and strata of the island are those shared by the other Perlas Islands.

In the search for an explanation of the peculiarities of San Jose Thicket, one more hypothesis remains to be considered. Perhaps the land which now can bear only thicket was formerly able to produce forest, but, because of serious modifications of its soils, lost this potentiality. This could possibly have resulted from prolonged mismanagement of extensive clearings in agriculture or from a natural catastrophe, a hurricane or drought followed by fire and widespread erosion. Such events could not have happened in recent history. They must necessarily have occurred over a century or more ago. The hypothesis assumes that soil in the thicket areas is actually poorer than that in the forested parts of the island. Its basic premise, until checked by comparative soil analyses, is pure supposition. As a working hypothesis, however, it seems the best that can be suggested for explaining the unusual behavior of the San Jose Thicket. It is the only one that cannot be demolished by the facts in hand.

If the soil over much of San Jose is poor, then the vegetation, not only in thicket areas but also in some of the forests, becomes understandable. Though generally poor, the quality of the soil could be expected to vary from place to place on the island. With an undisturbed cover of vegetation it could slowly improve. Over a great many years the humus content in the poor soils would increase. This would not be equal everywhere. Soil poverty may have originally varied from place to place or have originated at different times. Surface erosion could continuously impoverish some places and enrich others. As slow natural soil improvement progressed the type of vegetation it could and would support would change also, but at rates varying from place to place on the island. The poorest soils would support only

Low Thicket. As the quality of the soil very slowly improved a relatively more luxuriant vegetation could be supported. Bushy trees would appear in the Low Thicket, then progressively increase in abundance and slowly grow larger and eventually become arborescent in form. As soil conditions improved further the thicket would be transformed into forest. This vegetational sequence suggests that of second growth but is vastly more prolonged. A particular phase in normal second growth is merely a moment in the regrowth of a forest on land at the time capable of supporting forest. The vegetational phases on poor soil are evolutionary, the phase present at any time being the best the soil can then support, but probably not the best it will be able to support in the distant future after progressive improvement. This explains why clearings in the forests of San Jose produce normal second growth that gives every promise of rapidly replacing the destroyed forest, and why the original type of thicket growth promptly reclaims clearings made in thicket areas. Land when cleared will produce the most luxuriant vegetation it can support. With land varying in quality because of differing history and local conditions, it is not surprising that thickets illustrative of all the phases of relative luxuriance are today common and widely distributed on San Jose and frequently juxtaposed. It can be expected that as the soil supporting them is very slowly improved, the thickets will, bit by bit and very gradually over a long period, gain in luxuriance, and in the distant future become more and more like the North Forest and eventually indistinguishable from that type of forest. Indeed, North Forest may well be only an advanced stage in the evolution of more and more luxuriant vegetation that is correlated with the gradual natural improvement of soil conditions on San Jose. Nature progressing very slowly is perhaps giving San Jose a forested cover of the luxuriance characteristic of this region in the tropics.

NORTH FOREST

The name "North Forest" is applied to the most common type of forest found on the northern two-thirds of San Jose. It appears to be the kind of forest, at least on the northern parts of the island, into which the Thickets are being very gradually transformed. Where bushy trees in High Thicket continue to increase in size, the crowding has resulted in accentuated upward growth, the elongation of trunks, the raising of the treetops, and the eventual formation of this forest. In extreme states, Thicket and North Forest are very different in appearance. They are, however, merely early and later phases in one sequence of vegetational development. High Thicket grades into North Forest, and in many places the latter can be only arbitrarily delimited.

North Forest, broken here and there by areas of Thicket in various phases and by some Marino Forest and Deciduous Forest, dominates on the eastern peninsula, along most of the East Loop, on the southern and northern parts of the West Loop, and in most of the region about Bald Hill. Generally it is a rather poor, open type of forest. The trees are unequal in height, irregularly spaced, and interspersed with bits of thicket and much undergrowth. The canopy is generally uneven and broken. Travel in these open woods is accomplished only by use of the machete. In all these woods, however, there are places, small to large in extent, where the arborescent growth

is thicker. Here thicket is absent, and the crowded trees support a dense, rather even canopy 10–15 m. or more high.

The species of trees, shrubs, and vines common in and characteristic of the North Forest are as follows:

Principal canopy trees

**Xylopia frutescens*
**Phoebe Johnstonii*
**Hirtella americana*
**Pithecollobium rufescens*
**Andira inermis*
**Protium McLeodii*
Byrsonima crassifolia
Pera arborea
Ilex guianensis
Ternstroemia Seemannii
**Miconia argentea*
**Cordia alliodora*
Cordia bicolor

Secondary canopy trees

Coussapoa panamensis
Ficus Bullenei
Ficus Popenoi
Anona purpurea
Anona Spraguei
**Ocotea rubrinervis*
Spondias Mombin
**Bombax sessile*
**Didymopanax Morototoni*

Understory trees and shrubs

Hirtella oblongifolia
Ouratea guatemalensis
Calycolpus Warscewiczianus
Myrciaria ONeillii
Eugenia origanoides
Amaioua corymbosa

Common vines

Philodendron guatemalense
**Philodendron Erlansonii*
**Connarus panamensis*
**Cnestidium rufescens*
**Bauhinia Thompsoniana*
**Dioclea reflexa*
**Machaerium purpurascens*
**Clitoria portobellensis*
**Hiraea reclinata*
Tetrapteris discolor
Tetrapteris macrocarpa
Securidaca diversifolia
**Serjania nesites*
Gouania polygama
Cissus rhombifolia
Davilla lucida
Dolicarpus dentatus
**Tetracera volubilis*
Forsteronia viridescens
**Anemopaegma orbiculatum*
**Amphilophium paniculatum*
Arrabidaea pachycalyx
**Phyrganocydia corymbosa*
Chiococca alba

In the North Forest about a dozen kinds of trees predominate and in varying mixtures make up about 90 per cent of the canopy. These are listed above as the principal canopy trees. Usually present as scattered individuals are the secondary canopy trees. Among these latter are *Bombax* and *Didymopanax,* which grow to considerable size and not only reach the canopy but usually overtop it. The trees and shrubs of the understory, those growing inside the forest and shaded by the canopy, are common species found in similar situations in other forested parts of the island. They begin to appear in some of the very dense high thickets but become common and well developed only in true forest conditions. The vines, most of those common in High Thicket, are present in great abundance and variety in the canopy and on the margin of the forest.

As has been emphasized, many of the species important in North Forest are also important in High Thicket. These have been starred in the above list. In large areas of North Forest they predominate or alone are present.

In places, however, their predominance yields to such trees as *Ternstroemia* and *Ilex*, which are practically never present in thickets, even in their most advanced stages. These latter, and the other species unstarred in the lists, seem to be typical of established forest conditions. They appear only after such conditions have prevailed for some time, and accordingly seem to be a more advanced stage in forest development.

The two types of North Forest are readily recognized. What appears to be the younger type has its canopy made up largely of those species present in the later phases of thicket transformation. This type is usually characterized by an abundance of *Cordia bicolor* and *Cordia alliodora*. It is a common type of forest on northern parts of the island and tends to be broken and rather open. It is to be seen to good advantage along the East Loop Road and along much of East Road to the east of Red Hill. The other, a more mature type, that in which *Ternstroemia* abounds and *Ilex*, *Pera*, and *Byrsonima* are common, tends to have a denser and perhaps slightly lower and darker green canopy. It is well exemplified by the forest predominating along the first half-mile or so of South Road and that found at the south end of the West Loop. It is best developed in the central portions of the island, and its large stands are found mostly within about a mile of the Cross Roads. Some representative bits of this forest, however, occur as far north as Bald Hill. A characteristic one is to be found on the West Loop about a quarter-mile southwest of Bald Hill Road.

SOUTH FOREST

This is the prevailing forest type on the southern part of the island. It is the only one found from about the northern boundary of Area 2A southward along South Road and its branches. It is well developed on the hills at the mouth of the Rio Mata Puerco and on those southwest of Camp. The forests are rather dense in growth and have a rather even canopy 10–20 m. high. Bushy undergrowth is frequently abundant, but in most parts of this forest, with a moderate amount of digressing and some use of a machete, a traverse is easily made. Vines are less conspicuous than in other evergreen forests. The forest is broken by some patches of thicket, but these are generally smaller and much less numerous than in the North Forest. South Forest, unlike North Forest, rarely grades off into thicket. More common in South Forest than in other forests of the island are openings covered with a tangled mass of the clambering fern, *Dicranopteris pectinata*.

The South Forest greatly resembles those portions of the North Forest in which *Cordia bicolor* is a distinctly secondary tree and *Ternstroemia*, *Ilex*, and *Pera* are common. It differs from the North Forest in three important details. It covers much larger areas with uniform stand, it has a relatively even and unbroken canopy, and several distinctive trees are practically confined to it. These are differences which might be expected, if areas with the type of North Forest of the kind mentioned were with time allowed to thicken up slowly, expand, and mature. If those parts of the North Forest in which *Ternstroemia* and *Ilex* dominate represent a more mature phase in forest development than that in which *Cordia bicolor* is common, then the South Forest may well be a still later phase in the developmental sequence and hence some of the most mature forest on the island.

The composition of the South Forest may be tabulated as follows:

Principal canopy trees

Roupala complicata
Xylopia frutescens
Phoebe Johnstonii
Hirtella americana
Andira inermis
Protium McLeodii
Byrsonima crassifolia
Pera arborea
Ilex guianensis
Ternstroemia Seemannii
Cassipourea elliptica
Pouteria campechiana

Secondary canopy trees

Coussapoa panamensis
Ocotea rubrinervis
Ficus Bullenei
Zuelania Guidonia
Bombax sessile
Miconia argentea
Didymopanax Morototoni
Manilkara Chicle
Cordia bicolor

Understory trees and shrubs

Hirtella oblongifolia
Ouratea guatemalensis
Calycolpus Warscewiczianus
Myrciaria ONeillii
Eugenia origanoides
Amaioua corymbosa

Common vines

Philodendron guatemalense
Philodendron Erlansonii
Connarus panamensis
Cnestidium rufescens
Securidaca diversifolia
Hippocratea volubilis
Gouania polygama
Davilla lucida
Dolicarpus dentatus
Tetracera volubilis
Chiococca alba

In most parts of the South Forest *Ternstroemia*, *Ilex*, and *Cassipourea* are common and frequently dominate. Large trees of *Bombax*, *Didymopanax*, and *Manilkara* loom up well above the main canopy rather frequently. The trees *Cassipourea* and *Roupala* are very characteristic of the forest. They are common and widespread in South Forest. Only a few individuals of them have been observed beyond its limits. *Pouteria* and *Manilkara*, while not strictly confined to South Forest, are most abundant there. The *Pouteria* is frequently a very common tree in forests within a half-mile of the ocean and along with the *Manilkara* becomes especially abundant on forested headlands, particularly those on the southern half of the island. The shade-loving trees and shrubs of the South Forest are the same as those in the North Forest. The vines common in the South forest are fewer than those in either the North Forest or Marino Forest. The rarity of such vines as *Bauhinia* and the viny members of the Bignoniaceae is especially notable.

MARINO FOREST

The term "Marino Forest" is applied to those forests (PLATE 2) of San Jose which are of the same type as that well developed in the upper basin of the Rio Marino, in Area 7A. A small area of this forest-type is present on the ridge west of the Bald Hill grassland. There is another on the crest along the road just north of the grassland. Elsewhere on the island, however, the forests of this kind were found only on rather sheltered slopes and in valleys. Marino Forest is known at only two places near the sea, in both cases separated from the ocean by large mangrove swamps. One of these is

along the road just north of the Goat Barn. The other is situated close to Area 4C. They are the most southerly stations at which the forest has been found on the island. The most extensive development of the forest is that centering in Area 7A. Another large one is on the east slope of the island southeast of Bald Hill. Among some of the smaller stands worthy of mention are those in Area 8C, in 8D, and those near the south end of both Dead End and Bald Hill roads.

The Marino Forest is the most attractive high-canopy forest on the island. Its distinctive characters are largely determined by its dominant tree, *Tetragastris panamensis*, which usually grows 10–20 m. tall and commonly makes up 50 per cent or more of the dense dark green canopy. The tree is distinctly gregarious. Isolated specimens, distant from others of their kind, are extremely rare. When present the tree is practically always found in considerable abundance, at least locally. Growing as secondary species with *Tetragastris* in the Marino Forest are all the species, both primary and secondary, which are present in the canopy of the North Forest. In some areas of Marino Forest its secondary trees are predominately or entirely those which characterize the younger phase of North Forest, while in other areas they represent, in varying proportions, the older phase. The Marino Forest is certainly a more mature type than the earlier phases of North Forest. Perhaps it developed out of that latter type of forest in those particular localities where some special conditions permitted the *Tetragastris* to appear and eventually assume dominance.

The shade-loving trees and shrubs of the Marino Forest are mostly those found in the other forests of the island. Only one shade-loving shrub, *Ardisia compressa*, is confined to it. The canopy supports many vines, all those found in the North Forest, but among these *Bauhinia* reaches here its most spectacular development. Though *Bauhinia* is present and usually common in all forests and thickets on the northern half of the island, it is only in the Marino Forest that its dangling, sinuous, flattened, ribbon-like stems (the "Monkey Ladders") consistently reach such large size and become such a common and distinctive feature.

THE DECIDUOUS FORESTS AND OTHER VEGETATION ON THIN SOIL

Rock surfaces covered by thin soil, or those bearing small accumulations of soil where roughened by weathering, support a very distinctive flora on San Jose. Thin or scanty soil on bed rock is found on level areas up to several acres in extent and also on slopes and along crests of ridges, on ledges of sea cliffs, and on the tops of large rocks and islets along the coast of the island. During the rainy season such places are bountifully watered. The drainage is over the surface of the rock and is frequently very prolonged. Much water is collected in cracks and in the shallow depressions etched by weathering and is kept renewed by drainage and repeated storms. During the rainless season, however, the thin soil soon dries out. For several months of the year the areas of thin soil are as parched as any desert. The habitat is very different from those found elsewhere on the island, and is a very rigorous one. It is not surprising that it has developed a distinctive vegetation.

Some plants tend to be present wherever thin soil is found. Others, however, are more selective and appear to be influenced by degree of exposure

and especially by proximity to the ocean. Though there is a general similarity in vegetation on thin soil, there are several types that differ in composition and appearance according to location.

The most luxuriant growth on thin soil is the Deciduous Forest, which is best developed on the numerous relatively level areas scattered over the eastern peninsula. There it forms patches of distinctive woodland from a few hundred square yards up to several acres in extent that differ abruptly and conspicuously from the Thicket and North Forest that surround them. The dominant trees differ from those in other forests of the island. Most of them have distinctive habits of growth or unusual traits in bark, herbage, or fruit, that allow them to be instantly recognized. The woodland they form is unlike any other forest type on the island, particularly so during the dry season, when it is further distinguished by being mostly leafless. Occasional trees in other forests on San Jose may shed their leaves or thin them out temporarily during the rainless months, but only in the Deciduous Forests do most of a group of associated trees shed their foliage and remain leafless during most of that season.

The distinctive character of the Deciduous Forest is obvious to the most casual observer. As one enters this woodland it is as though he had stepped out of the crowded tropical vegetation into some fine old grove of trees in the United States. One is instantly impressed by the broad crowns of the dominating trees, the loose spacing of the large trunks, the large exposed roots spreading over the rocky soil, the relative sparsity of vines and undergrowth, and especially by the abundance of grass and low herbs which, in season, give a green carpet to the forest floor. There is space under the canopy, and one can move about easily without a machete. The Forest furnishes a good place to eat one's lunch, or even to have a picnic.

In well-developed bits of Deciduous Forest *Cedrella fissilis* tends to be the most common large tree. With occasional large specimens of *Bombax quinatum* it frequently makes up much of the canopy, which may be continuous or somewhat broken and is generally 6–15 m. in height. Large individuals of *Bursera Simaruba* and *Spondias Mombin* are usually present also, and trees of *Caesalpinia eriostachys, Luehea candida, Cochliospermum vitifolium,* and *Guazuma ulmifolia* likewise join them in varying abundance. Other woody plants frequently found in this association are *Coccoloba Waittii, Spondias purpurea, Allophyllus occidentalis, Matayba glaberrima, Casearia banquitana, Pouteria stipitata, Stemmadenia grandiflora,* and *Guettarda odorata.* Vines are few. The most interesting is *Cissus sicyoides,* a species apparently restricted to thin soil. The most conspicuous low plant is the Piñuela, *Bromelia Karatas.* In any bit of Deciduous Forest numerous clumps of its thorny leaves are always present, and frequently it alone is at hand to mark some outlying scrap of thin soil perhaps only a few square yards in extent. Between the exposed tree roots in shaded places two small annual herbs, the grass *Oplismenus Burmanni* and the club moss *Selaginella diffusa,* usually luxuriate at the close of the wet season, carpeting the soil of the forest floor. In sunny openings in the forest herbs such as *Waltheria americana, Desmodium angustifolium, Sida linifolia,* and *Jacquemontia tamnifolia* are found. Clumps of the coarse grass *Tripsacum lanceolatum* are occasional there also, and on San Jose are confined to this special habitat.

Well-developed groves of Deciduous Forest such as have been described are practically confined to the eastern peninsula. Good examples of them may be seen north of the midsection of the Air Strip (PLATE 3), near East Road at the boundary between Areas 8A and 8B, and at the south end of the East Loop Road. They occur inland as far as the south corner of Area 8C. In the center of the island they were encountered only in Area 7C and just to the eastward near the giant *Bombax quinatum* that stands as a landmark by the West Loop. Near the coast they occur only in sheltered places, as for example near the Air Strip and in ravines close to the shore east of Area 8D or back of Mango Beach.

Found in various places about the island are groups of trees which, though not representing the well-developed Deciduous Forest we have been discussing, can be recognized as bits of the same type of vegetation. Many are found along rocky ridges, as at Max Point. A number of them occur on the ridges and slopes to the east and within sight of Camp. A rather large one is on a ridge south of the midsection of Canyon Road. Numerous examples can be seen on the headlands along the west coast of the island. During the dry season, when they are leafless, they may be spotted from a distance. They are not uncommon. Though limited as to the number of individuals, they contain some or even all of the species that characterize the large groves of Deciduous Forest. In all cases they have developed on small areas of thin soil. At Max Point, for example, there are scattered trees of *Bombax*, *Bursera*, *Cedrella*, *Spondias purpurea*, *Coccoloba*, *Cochliospermum*, *Stemmadenia*, as well as *Bromelia* and *Cissus*, all localized on the thin soil along a short ridge. Though no forest is formed, the vegetation is essentially the same as that present in well-developed Deciduous Forest; the difference is only in quantity.

A vegetation rather different from that in the Deciduous Forest, however, may develop on thin soil close to the sea. Especially notable are the several acres of thickety growth and interspersed grassy areas that have developed on the scanty soil which covers the horizontal beds of rock topping the sea cliffs on the point of land at the west side of East Harbor (PLATE 3). This vegetation is probably similar to that which may be found at some other places along the coast. It was accessible for study, however, only at East Harbor. Though restricted in occurrence it displays an unusually rich and distinctive flora.

The trees and shrubs on the area at East Harbor are mostly small in size. They form a loose thickety growth, generally 2–4.5 m. tall, which is only here and there overtopped by emergent trees up to 9 m. tall. With a little difficulty a passage may be worked through this woody vegetation without the use of the machete. The trees and shrubs present are *Caesalpinia eriostachys*, *Bursera Simaruba*, *Bunchosia cornifolia*, *Matayba glaberrima*, *Luehea candida*, *Apeiba Tibourbou*, *Bombax quinatum*, *Guazuma ulmifolia*, *Cochliospermum vitifolium*, *Casearia banquitana*, *Eugenia origanoides*, *Myrcia tomentosa*, *Psidium guineense*, *Stemmadenia grandiflora*, *Plumeria rubra*, *Cordia panamensis*, *Tabebuia pentaphylla*, *Guettarda odorata*, and *Genipa americana*. *Bromelia* grows in the shelter of the thicket. The large vines are *Odontocarya nitida*, *Dioclea megacarpa*, *Cissus sicyoides*, and *Marsdenia margaritaria*. Most of these species are typical of well-developed Deciduous Forest, a bit of which is present on the landward side of the area. The

Bunchosia, *Matayba*, *Myrcia*, *Psidium*, and *Plumeria*, however, are plants most common along the coast. The *Genipa* is a tree known on the island only at this place.

The very abundant herbs at East Harbor are largely concentrated in open areas interspersed among the thickets. These open places, some small, others large, are sharply delimited, and except for an occasional gnarled specimen of the savanna tree *Curatella americana* are dominated by the herbs. In season the areas are green with a luxuriant growth of grasses, sedges, and other small plants, practically all annuals. All this develops on what during the dry months may be almost bare volcanic rock. The rock surface, however, is covered with small pits and many shallow pan-like depressions in which some soil has collected. During the rainy season these are kept filled with water or constantly moistened by slow surface drainage. For part of the year conditions are favorable for the growth of short-lived, moisture-loving savanna plants. One large water-filled erosion-pocket, a half meter deep and a meter broad, is even suitable, in fact, for the floating aquatic *Rotala mexicana* and some coarse clumps of *Eleocharis interstincta*. The relative richness and the distinctive character of the herbaceous flora at East Harbor is shown in the following partial listing of its species. Those starred are known only from East Harbor. The remaining ones have been found at other places along the island coast, and a few on the Bald Hill grassland also.

Anemia pastinacaria (a fern)
Andropogon angustatus
Andropogon brevifolius
**Aristida jorullensis*
**Aristida ternipes*
**Leptochloa filiformis*
Oplismenus Burmanni
Panicum molle
**Paspalum clavuliferum*
**Pentarrhaphis scabra*
Setaria tenax
Sporobolus ciliatus
Cyperus diffusus
Cyperus ligularis
**Cyperus tenerrimus*
Dichromena ciliata
**Eleocharis interstincta*
**Fimbristylis annua*
**Rynchospora armerioides*
Rynchospora micrantha
**Rynchospora mexicana*
Scleria interrupta
Scleria micrococca
**Scleria setacea*
Dioscorea sapindoides
Maranta arundinacea
Bletia purpurea
Brassavola nodosa
Habenaria pauciflora
**Mimosa pusilla*
**Cassia diphylla*
Aeschynomene americana
Aeschynomene brasiliana
Calapogonium mucunoides
Clitoria rubiginosa
Desmodium barbatum
Phaseolus longipedunculatus
**Phaseolus stenolobus*
**Polygala bryzoides*
Polygala longicaulis
**Croton trinitatis*
**Phyllanthus carolinensis*
Phyllanthus diffusus
Sida linifolia
Waltheria americana
Sauvagesia pulchella
Sauvagesia tenella
**Rotula mexicana*
**Acisanthera quadrata*
Pterolepis pumila
Schwackaea cupheoides
Spigelia Anthelmia
Coutoubea spicata
**Schultesia guianensis*
Evolvulus filipes
Jacquemontia tamnifolia
Hyptis pulegioides
Hyptis recurvata
**Marsypianthus Chamaedrys*
**Buchnera* sp.
Kohleria tubiflora
Mitrocarpus breviflorus
Borreria densiflora
Borreria latifolia
Borreria ocymoides
Spiracantha cornifolia
Pectis elongata

The tops of rocks and islets scattered along the coast of the island, as well as ledges on the sea cliffs, are also sites where thin-soil conditions prevail. The rocks and islets close to shore usually bear at least a few gnarled trees. *Bombax, Bursera,* and *Cochliospermum* are most generally represented. The most frequent shrubs, if any, are usually *Plumeria, Guettarda,* and *Calea. Agave* is found only in these situations. The rocks, islets, and sea cliffs are the favored habitat for the cacti. Frequently all three of the island species may be present on a small rock off shore. That hardy orchid, *Brassavola nodosa,* is always found on bare rocks along the coast, where it is one of the common and characteristic plants. *Bromelia Karatas,* always present where there is thin soil, finds a congenial home on many of the rocks, islands, and cliffs along the coast. The bits of soil collected in the rough surface of the volcanic rocks are adequate for a variety of herbs. During the wet season these herbs furnish a green covering to the top of most rocks along shore. The common ones are the same as the unstarred species previously listed as growing above the cliffs at East Harbor. Several additional ones, however, can be added, namely, *Polypodium Kuhnii, Axonopus capillaris, Peperomia pellucida, Euphorbia glomerifera, Sida linifolia.*

STREAMSIDE FORESTS

Forests of this type have a limited distribution on the island. It is the kind of vegetation which demands the rather steady supply of soil moisture available only on stream banks, on alluvial terraces bordering streams, or in places kept moist by springs. Unlike forests in other situations, those developing along streams are only moderately affected by the prolonged dry season. They have a constant water supply and can maintain high humidity under their canopy. Their soils, accumulations in the valley, are richer than those in adjacent terrain. They are, accordingly, the most luxuriant type of vegetation developed on the island.

The common trees characteristic of Streamside Forests are *Anacardium excelsum, Luehea Seemannii, Licania platypus, Ficus Campbellii,* and *Ficus crassiuscula.* They are among the very largest and tallest trees growing on the island, frequently becoming 25 m. or more in height. Distinctive secondary trees in this type of forest are *Piper, Inga spuria, Guarea culebrana, Mabea occidentalis, Marila macrophylla, Gustavia superba, Trichanthera gigantea,* and *Macrocnemum glabrescens.* The spiny Black Palm, *Bactris balanoides,* abounds in this habitat. A number of herbaceous plants are abundant enough to become features of it also. The climbing aroids *Philodendron Erlansonii* and *P. Harlowii* are notable, as is also the Dumb Cane, *Dieffenbachia,* which grows commonly in and along streams. The largest colonies of the thorny-leaved Wild Pineapple (*Aechmea magdalenae*) grow in the shade of Streamside Forests. Most of the kinds of orchids known from San Jose find their home on the trunks of its giant trees.

An abundance of giant trees, the most distinctive feature of well-developed Streamside Forest, is found only in scattered places on the island. Along most streams these giants grow singly, and only here and there are they grouped to make more than a thin, interrupted strip of high forest. Some of the most interesting examples of this kind of forest can be noted. An abundance of lofty, giant streamside trees forms a fine gallery forest in

the valley in Area 11B. Because of the number of great trees, the spaciousness under the canopy, and the fine stream, it is one of the most scenic and inviting tracts of forest on the island. The most extensive stand of Streamside Forest on San Jose has developed on about ten acres of springy bottom land at the east side of Area 4, just south of the mangrove swamp. The dominant trees are *Anacardium* and *Luehea,* mostly 20–25 m. tall. Some smaller but still characteristic bits of this type of forest are to be seen near the main roads in Pump Valley and on the springy west slopes of Red Hill. The very interesting Streamside Forest in Camp Valley, that back of the E. M. Barracks and Motor Pool, merits special comment. It has a composition unlike other forests of this type on the island. A number of its species grow nowhere else on San Jose, at least not in such abundance. The giant trees are *Anacardium excelsum, Luehea Seemannii, Ficus crassiuscula, Ficus Campbellii,* and *Ficus Dugandii.* The last mentioned is confined to Camp Valley. This is also the case with two secondary trees, *Guarea culebrana* and *Guarea guara. Gustavia superba,* though fairly common in Streamside Forest in Area 11B, simply abounds in the Camp Valley. Along with the very abundant *Guarea culebrana* it contributes much to the distinctive aspect of the forest found there.

COASTAL-SWAMP FORESTS

These are forests found behind barrier beaches in Bodega Bay, at Navy Cove, back of Playa Grande, and at a few other scattered places along the coast of the island. They develop in places periodically flooded by sea water or by fresh or more or less brackish water backed up by the rising tides. They vary in composition according to the depth and salinity of the periodic inundations to which they are subjected.

The best-known plant in coastal swamps is the true mangrove, *Rhizophora brevistyla,* which may be bushy and supported above the tides on many slender stilt roots, or, as is frequent on San Jose, a tree 10–20 m. tall with a single heavy cylindrical trunk elevated above the high-tide level on large prop-roots. It grows in places sheltered from surf, where the flooding of sea water at high tide may reach a meter or more in depth. Where the maximum inundation of sea water is only a few decimeters in depth, the mangrove is joined by *Pelliciera rhizophorae,* a tree with an unusual fluted conic thickening at the base of its trunk. In parts of the swamp with soil levels at or just below average tides, where flooding is shallow and even infrequent, trees such as *Avicennia nitida, A. bicolor,* and *Laguncularia racemosa* predominate.

Where large streams enter coastal marshes the incursion of sea water at high tide periodically backs up the streams flow. Some parts of the marsh, accordingly, are flooded by salt water, others by fresh water, and the intermediate areas with varying mixtures of the two. Along the Rio Marino the effects of tidal influence can be found for a half-mile inland, but elsewhere on the island it is rarely evident for more than a hundred yards back from the coast. The characteristic tree of areas flooded by merely brackish water is *Mora oleifera.* Good stands of it, growing in its particular habitat, are to be seen back of Main Beach and near the head of tidal influence along the Marino, half way between Red Hill and Playa Grande. Only near the stream mouth in the swamp back of Main Beach is there a large level area of swamp periodically flooded by fresh water backed up by tidal action.

The characteristic trees here are the elaborately buttressed *Pterocarpus officinalis* and the erect-growing, thorny-trunked aroid *Montrichardia arborea*. Several other distinctive plants of the coastal swamps should be mentioned. These are the coarse fern *Acrosticum aureum*, the vine *Rhabdadenia paludosa*, and the large bushes *Enallagma latifolia* and *Tabebuia palustris*, all frequent in shallowly flooded brackish swamp soils.

The small swamp back of Main Beach has one of the most representative growths of Coastal-Swamp Forest found on the island. The swamp at the head of Bodega Bay, at the mouth of the Rio Mata Puerco, is covered with bush mangrove. The large mangrove swamp back of the southern middle section of Playa Grande has a fine stand of arborescent, as well as bushy mangrove, some *Pelliciera*, and towards the shallow northern end a good growth of *Laguncularia* and *Avicennia*. The extensive swamp forest at the mouth of the Rio Marino is mostly *Laguncularia* and *Avicennia* with only occasional trees of *Rhizophora*, *Pelliciera*, and *Mora* present.

BEACH VEGETATION

Plants of this class include those growing on beaches, mostly above high-tide levels but within the reach of storm water. Practically all are disseminated by ocean currents, and hence are widely distributed on beaches in the tropics. The Coconut Palm, *Cocos nucifera*, and the poisonous Manchineel, *Hippomane Mancinella*, are the best-known trees of sandy beaches. They are conspicuous on many beaches of San Jose. *Conocarpus erecta*, a small tree or large shrub, though generally unrecognized by the non-botanist, is equally characteristic of strands and is even more generally distributed on the island. Other less obtrusive, much less common trees growing on the upper parts of sandy beaches are *Ximenia americana*, *Ficus Leavensii*, *Lonchocarpus pentaphyllus*, and *Elaeodendron xylocarpum*. A number of herbs are confined to stabilized beach sand: *Uniola Pittieri* (Beach Grass), *Pancratium littorale* (Spider Lily), *Canavallia rosea*, *Phaseolus adenanthus*, *Vigna repens*, and *Ipomoea pes-caprae* being the most common. The dense thickety growth developing at the head of many sandy beaches is also characteristic. The principal shrubs are *Dalbergia Brownei*, *Hibiscus tiliaceus*, and *Tecoma stans*. They are usually heavily draped with *Entada Gigas* and with other vines and scramblers such as *Caesalpinia Bonduc*, *Mucuna Mutisiana*, *M. Sloanei*, *Heteropterys macrostachya*, and *Omphalea panamensis*. A number of distinctive plants grow only in the sand at Playa Grande about the tidal inlet at the mouth of the Rio Marino. The thorny tree *Prosopis juliflora* and the sedge *Fimbristylis spadicea* grow there on the drier sand, and the grasses *Jouvea straminea* and *Sporobolus virginicus* on the sand periodically flooded by the tide. On sheltered shingle beaches *Conocarpus erecta*, *Laguncularia racemosa*, and rarely *Avicennia nitida* are the only trees, and in fact, with the exception of an occasional patch of *Sporobolus virginicus*, are the only vegetation other than algae which these rocky strands support.

GROWTH ON CLEARINGS

The blades of the bulldozers affected the vegetation of San Jose spectacularly and widely. The forests and thickets were knocked down, commonly uprooted, and relentlessly brushed aside in the making of camp sites, air

strip, and miles of road. Top soil was usually destroyed in the process. Much of the destroyed vegetation was disposed of by burning. Nevertheless the raw soil of shoulders, ditches, and banks along roads, and the unused portions of clearings that had been exposed before midyear of 1944, were mostly covered with seedlings of vines and trees before the end of the rainy season of that first year. Along sections of the road between Camp and East Harbor, the first of the major roads to be put through, seedlings of *Cecropia* (Guarumo), *Ochroma* (Balsa), and *Trema* appeared in great numbers, and growing with astonishing rapidity frequently reached 1.5–2.5 meters, and occasionally 3 meters in height by November. About Camp cleared and graded areas left essentially undisturbed during the rainy season were covered by herbaceous and woody vines, young bushes of *Callicarpa*, and many seedling trees of *Cecropia*, *Trema*, *Byrsonima*, *Apeiba*, and *Ochroma*. The new vegetation about Camp was 0.5–2.5 m. high by November 1944, scanty in some places and thick in others. Along roads cut through dense forests the growth was much less abundant and rapid. Some *Cecropia* appeared there, but more characteristic were the seedlings of *Byrsonima*, *Zanthoxylum*, and *Cordia bicolor*. Areas cleared late in the rainy season of 1944 or during the following dry period had feeble or few seedling trees by March 1945. Seedling trees appear chiefly during the rainy season and seem to need several months of rain to become sufficiently well established for persistence during their first dry season. Once established, however, they can continue to elongate during their initial dry season and increase their height as much as 25 per cent.

By January 1946 the new growth on cleared land had benefited from two complete rainy seasons. Variations in behavior had become evident. The weed trees, *Trema*, *Cecropia*, and *Ochroma*, had developed best on clearings made in Thicket and open North Forest. The most luxuriant stands of them were along East Road towards the Air Strip. There *Ochroma* had become 6–9 m. tall and had trunks 10–18 cm. thick breast high, while *Cecropia* had attained 6–8 m. in height and a trunk up to 10 cm. thick, and *Trema* had reached 6 m. in height with the trunk 5–10 cm. in diameter. They formed a very dense, forest-like growth at the roadside. About Camp and along most roads, however, the weed trees were generally only 3–4.5 m. tall, only here and there approaching 5–6 m. in height. The slower growing plants that had previously occupied the cleared land had in many places got reestablished, had grown in size, were becoming noticeable among the weed trees and were beginning to offer effective competition for control of the terrain. Where the growth of weed trees was very dense these still continued to dominate. Along most roads, however, the scrambling shrubs *Cordia ferruginea* and *Solanum extensum* were well established among them. These, as well as other plants, had spread from adjacent undisturbed vegetation and were beginning to crowd the second growth. The indications were that in a few more years the shrubs and vines of the Thicket would crowd out and smother most of the *Trema* and many of the slower growing individuals of *Cecropia* and *Ochroma* also. Some *Ochroma* and *Cecropia* would persist, looming above the Thicket as emergent trees. Where growths of weed trees had been cut down in road maintenance, plants originally on the terrain had, by means of suckers and seedlings, got well started in regaining complete

control of the area, since after the soil is more or less stabilized few if any seedlings of the weed trees appear.

Along roads in well-forested areas the growth of the weed trees had been conspicuously less successful than in naturally open situations. In many forests they had appeared in only moderate or even limited numbers and had not grown very vigorously. This was especially the case with *Ochroma*. On most clearings in forested areas the seedlings of the forest species were competing successfully with the weed trees and giving every evidence of being able to replace the destroyed forest eventually. Much Saw-grass, *Scleria secans*, was established at forest roadsides, but this would thin out as the forest canopy was gradually reclosed. In most forests *Cordia bicolor* proved itself to be the most rapidly growing of the forest trees.

By 1946, only two years after the forests and thickets had been disturbed by roadmaking, it was clear that the destroyed vegetation was capable of returning rather promptly in all places where it had been removed. Even though the soil had been swept clear and churned by bulldozers, areas on Marino Forest were regaining that type of forest, those in Thicket were regaining Thicket, and those in North Forest and South Forest were likewise in process of regaining their particular types of original vegetation. It had been believed that much of the vegetation on San Jose was in various stages of ordinary second growth, with Low Thicket, High Thicket, and open North Forest being principal stages in regrowth of forest on formerly cleared land. By 1946, however, it was evident that regrowth in Marino Forest, South Forest, and dense North Forest would not go through these supposed stages.

During the first dry season, beginning in late 1944, a number of native herbaceous plants spread with great rapidity on cleared land and amidst the new tree growth on it. In November 1944 *Mikania micrantha*, *Jacquemontia tamnifolia*, and *Merremia umbellata* were known only on thin soils in open places near East Harbor, but by the following March they were common and in some places extremely abundant, covering clearings and climbing in new growth along roads in all parts of the island. In November *Waltheria americana* grew on thin soils on the eastern peninsula and a few plants were present on cleared land at Camp. By March it had become common along many stretches of road. It has since spread all over the island. The thorny clambering *Solanum lanceifolium*, an infrequent plant in thickets and in open forests in November had by the following March become rather common and obnoxious along many roadsides. Likewise the clambering sedge *Scleria secans*, formerly an occasional nuisance in forests, appeared in great abundance in cleared places along roads, chiefly in forests, but all too commonly in thicket areas also. New growth at roadsides, in fact, proved to be a congenial habitat for most of the native herbaceous vines. Among those which formerly were only occasional, but had become frequent or common along roads by 1946, were *Lygodium venustum* (a twining fern), *Dioscorea polygonoides*, *Passiflora biflora*, *Mandevilla subsagittatum*, *Prestonia portobellensis*, *Fischeria Martiana*, *Melothria guadalupensis*, *Melothria trilobata*, and *Sabacea villosa*. In November 1944 the native grass *Paspalum nutans* was common at roadsides, creeping over banks and among the young weed trees. By January 1946, however, it had largely disappeared, apparently crowded out by another native grass, *Lasiacis oaxacensis*, which the year before had begun a delayed but rapid spread along roadsides. It is

a notable fact that many of the native plants which have spread widely and abundantly along roads were formerly confined to open places with thin soil, chiefly along and near the coast. Representative of this class and not previously mentioned are *Cyperus ligularis* and *Setaria tenax,* and the white-backed fern *Pityrogramma tartarea.* By 1946 the *Cyperus* and *Setaria,* though not common, were generally distributed in loose soil on road shoulders over most parts of the island.. The fern, formerly largely confined to sea cliffs, had by 1946 appeared in numbers on the banks of many road cuts and road shoulders in the interior of the island.

Some of the abundant new growth on the clearings of San Jose Island seems to be correlated with the mixing, loosening, and churning of the soils by bulldozers. A small thicket area near the end of the eastern peninsula, burnt over before the middle of 1944, was well advanced in replacing its destroyed vines and bushes by root and stump sprouts by January 1946. No seedlings of the weed trees had appeared in the burnt-over area, although these trees had appeared and flourished in the bulldozed soil at the edge of the Air Strip on its margin. The original Navy Road, abandoned and largely replaced by the Navy Cove Road made by bulldozers in November 1944, was cut and grubbed by hand. A dense growth of *Trema* and *Cecropia* developed along the new Cove Road where it traversed thicket, but along a near-by paralleling stretch of the old abandoned road only a few of these trees had appeared by 1946. The rapidly growing trees such as *Cecropia, Trema,* and *Ochroma,* which appeared so abundantly along bulldozed roads, are well-known ones in Central America, where their astonishing behavior is similar to that demonstrated on San Jose. They may appear in incredible numbers on new forest clearings and, surprisingly, even in places far from any visible source of seeds. The only explanation is that dormant seeds of these plants are widely distributed and abundant in tropical soils and are capable of prompt germination when the land is cleared and the soil disturbed. Curiously, on San Jose, plants from such seeds did not appear on land cleared by fire, ax, or machete. They did appear abundantly on land cleared and disturbed by bulldozers. It seems, therefore, that this machine, in churning the soil, disinters seeds capable of giving a rapidly maturing aborescent cover to the very soils it disturbs so profoundly.

A few native plants of San Jose have been introduced into new parts of the island by other than natural means. The most interesting examples of this are those effected by sandbags, filled at beaches in Bodega Bay and transported to various places on the island. The seeds and bulbs of seashore plants contained in these bags sometimes grow with surprising results. A well-developed plant of *Pancratium* (Spider Lily) was found growing on a sandbag in dense Marino Forest along Grabby Clutch Trail. About a broken sandbag on the Bald Hill grassland there was a well-developed colony of *Phaseolus adenanthus, Canavalia rosea,* and *Ipomoea pes-caprae,* all seashore plants. During 1945 clumps of *Trachypogon* and *Axonopus* were dug up at Bald Hill and replanted on banks of fill at the Cross Roads and about Headquarters as a part of erosion control. These plants were alive in January 1946, but being bunch grasses they had not spread. Apparently transported with them, however, were roots or seeds of *Centrosema.* That small but handsomely flowered vine was doing well on the bank at the Cross Roads and getting well established there at this time.

IMMIGRANT WEEDS

With a large population established on San Jose and frequent intercourse maintained with the mainland, it was to be expected that those plants which follow Man, the common weeds, would soon be established on the island also. The rapidity with which these plant migrants follow civilization was beautifully demonstrated on the island. When the Navy established its small station on San Jose about October 1943, and the Army commenced its extensive operations there in January 1944, none of the weeds were growing on the island. The island had been uninhabited for at least eighty years. The sites of all previous settlements had been obliterated, and native vegetation prevailed in all parts of the island. By January 1946, about two years later, 114 immigrant weeds had reached San Jose Island.

The history of this immigration is best shown by observations made at the center of human activities on the island and the near-by port of entry, that is, Main Camp and Main Beach. In November 1944 patches of *Cynadon Dactylon* were growing at the Officers Club. A few plants of *Mimosa pudica* were established near the hospital. A number of colonies of *Eclipta alba* were growing about Camp and at Main Beach. Back of the beach *Dactyloctenium aegyptium* was rather common and a few plants of *Panicum maximum* were getting started. By the following March none of these plants had increased much in abundance. *Cenchrus Brownii,* however, was discovered along the road in front of the E. M. Barracks, and further down the same road toward the beach fruiting plants of *Erigeron bonariensis* were found. A dozen plants of *Alternanthera* were fruiting near headquarters. *Sporobolus indicus* was established at the roadside back of Main Beach. During the next six months, up to and including September 1945, Erlanson and, later, Harlow collected the following newly established immigrants in the area:

Echinochloa colonum	May	*Eleusine indica*	June
Fimbristylis annua var. *diphylla*	May	*Cyperus rotundatus*	June
Euphorbia glomerifera	May	*Euphorbia hirta*	June
Corchorus siliquosus	May	*Commelina elegans*	July
Capraria biflora	May	*Tridax procumbens*	July
Eleutheranthera ruderalis	May	*Desmodium triflorum*	August
Vernonia cinerea	May	*Paspalum paniculatum*	September
Digitaria sanguinalis	June	*Boerhavia coccinea*	September

By the first of January 1946 a large weed flora was established and evident in waste ground and along roads both at Camp and at the beach. *Cenchrus* had become a pest, and one did not have to look far for specimens of *Digitaria* or *Echinochloa.* Practically all the twenty-five weeds previously found had spread and increased in abundance. Many new immigrants had joined them. During the third quarter of 1945 there had been gardening activity at Camp, ornamental shrubs had been set out, and much lawn planted. Plants and lawn cuttings had been brought from the Canal Zone and the seeds of many weeds had come with them. Manure from the Goat Barn, used as fertilizer, had been another source of weeds. It is not surprising that a veritable host of new weeds had appeared by January 1946 in the planted areas at Camp. Immigrant plants first found at Camp and Main Beach in January 1946 are listed below. Those starred were found only on the new lawns.

Axonopus compressus
Hyparrhenia rufa
**Ischaemum ciliare*
**Leptochloa virgata*
**Panicum laxum*
**Panicum purpurascens*
**Polytrias praemorsa*
**Setaria geniculata*
Cyperus compressus
**Cyperus esculentus*
Fimbristylis miliacea
**Commelina diffusa*
**Tripogandra elongata*
**Tripogandra floribunda*
**Rumex* sp.
**Amaranthus hybridus*
**Celosia argentea*
**Chenopodium murale*
**Portulaca oleracea*
**Brassica nigra*
Anona glabra
**Aeschynomene americana*
Aeschynomene sensitiva
Alysicarpus vaginalis
**Desmodium canum*
**Desmodium Scorpiurus*
Phaseolus lunatus
**Acalypha arvensis*
**Caperonia palustris*
**Croton hirtus*
Euphorbia glomerifera
**Phyllanthus Urinaria*
Hibiscus esculentus
**Sida acuta*
**Melochia melissaefolia*
Turnera ulmifolia
**Cuphea carthagenensis*
**Jussiaea erecta*
**Jussiaea suffruticosa*
**Spigelia Anthelmia*
Hyptis capitata
**Salvia occidentalis*
**Physalis angulata*
**Bacopa procumbens*
**Stemodia durantifolia*
**Blechum pyramidatum*
**Nelsonia brunelloides*
**Justicia comata*
**Justicia pectoralis*
Elephantopus spicatus
**Emilia sonchifolia*
**Melampodium divaricatum*
**Sonchus oleraceus*

An analysis of the list given above reveals that a number of the species growing in the lawns at Camp are of kinds usually restricted to wet soils, viz., *Cyperus esculentus, Caperonia palustris, Jussiaea erecta, Jussiaea suffruticosa, Justicia comata, Justicia pectoralis,* and *Nelsonia brunelloides.* This seems to indicate that the lawns at Camp were started with cuttings from stock grown in low ground on the Isthmus. This being the case, a source is suggested for two woody plants, *Anona glabra* and *Aeschynomene sensitiva*, species commonly confined to wet soil, which also appeared at Camp, where they are certainly neither native nor deliberately introduced.

Plants accidentally established on San Jose since the Army occupied the island have not all been of species previously unrepresented in the flora. In at least four clear cases, *Aeschynomene americana, Euphorbia glomerifera, Spigelia Anthelmia,* and *Eleutheranthera ruderalis,* species native in remote parts of San Jose have had new colonies established in the Camp area by seeds recently transported directly from the Isthmus. Similar happenings are suspected in the case of *Desmodium procumbens, Euphorbia thymifolia, Phyllanthus diffusus, Borreria latifolia, Borreria ocymoidea* and *Melanthera nivea.* All of this latter group were found growing in the lawns at Camp, where their behavior was that of recently introduced plants. Elsewhere on the island, however, they grow near the coast, most of them on rocks and cliffs along the shore, and give every evidence of being native. It is not impossible that some of them may grow undetected on the sea cliffs near Camp and may have spread from there to the lawns near by. This may explain the presence in the lawns of some of these species, but certainly not of all of them. It seems much more likely that some or all of them have appeared in the lawns as the result of seeds transferred from the mainland.

The record of introduced weeds at the Navy Station makes an interesting comparison. The Station, a few buildings, and about a half-acre of clearing had no overland connection with the Army Camp until November 1944. It had been supplied by a monthly boat from the mainland. Gardening activities began shortly after it was established. In November 1944 there were bits of lawn of *Cynodon* and *Polytrias* and some fruit trees well established, as well as a vegetable garden and some flower beds. The weeds noted at that time were *Pennisetum setosum, Setaria geniculata, Sporobolus indicus, Mimosa pudica, Sida acuta, Scoparia dulcis, Blechum pyramidatum, Emilia sonchifolia,* and *Tridax procumbens. Hyptis capitata* was first noted in April 1945. During May 1945 Erlanson obtained there *Desmodium canum* and *Calonyction aculeatum,* and the next month *Paspalum paniculatum, Amaranthus dubius, Eleutheranthera ruderalis,* and *Melampodium divaricatum.* Observations made at the Navy Station in January 1946, nearly six months after it had been abandoned, showed most the species that have been listed as still present and very common. Present also were four immigrants not yet recorded for the locality, namely, *Cenchrus Brownii, Desmodium Scorpiurus, Hibiscus esculentus,* and *Capraria biflora.* None of the weeds growing at the Navy Station showed any tendency to spread inland along the roads. Very likely the *Cenchrus* was introduced there from the Army Camp by burs attached to clothing. The other weeds, however, seem to be the direct result of Naval operations, and accordingly had a mainland source different from that of those found about the Army Camp. Even so, practically all the species of weeds at the Navy Station eventually appeared also at the Army Camp.

The weeds that appeared about the Goat Barn are a surprising lot. They are not the common weeds of Panama, but some from the United States, apparently introduced in unclean hay. Judging from the species represented, their original source may have been Texas or adjacent states to the north or east. They appeared in the abandoned goat corral, about some old rabbit hutches, near the main barn, on the clearing where bales of hay had formerly been piled, and to some extent on the roadside near by. Though originally confined to the vicinity of the Goat Barn, some have been given a wider distribution on the island by the transportation of goat manure for use as fertilizer. Manure and straw from the Goat Barn used on the lawns at Camp probably account for the presence there of *Commelina, Brassica,* and *Sonchus.* A clearing near the road between Camp and the Goat Barn had in January 1946 a conspicuous growth of the same *Commelina* and *Ipomoea* which abounded at the latter place. The ground had been prepared for the eventual planting of fruit trees by working in straw and manure from the Goat Barn.

A list of the introduced plants found at the Goat Barn is given below. Those starred were apparently introduced from the United States in unclean hay. Fruiting plants of rice, oats, broomcorn, and milo were noted at the Barn but are not included in the list.

**Axonopus compressus*
Cenchrus Brownii
**Cynadon Dactylon*
Digitaria sanguinalis
Echinochloa colonum
**Echinochloa crus-pavonis*
Eleusine indica
**Eragrostis Barrelieri*
**Eragrostis cilianensis*
**Eragrostis curtipedicellata*
**Eragrostis spectabilis*
**Leptochloa virgata*

**Panicum hians*
**Panicum tennesseense*
**Setaria viridis*
**Sorghum halepense*
Sporobolus indicus
**Commelina diffusa*
**Rumex Acetosella*
**Rumex* sp.
**Amaranthus albus*
**Amaranthus hybridus*
**Amaranthus retroflexus*
**Amaranthus spinosus*
**Chenopodium leptophyllum*
**Mollugo verticillata*
**Brassica nigra*
**Potentilla norvegica*
**Sesbania Sesban*
**Trifolium pratensis*
**Trifolium repens*
**Abutilon Theophrasti*
**Malva neglecta*
**Melochia corchorifolia*
**Ammania coccinea*
**Ipomoea hederacea*
**Plantago major*
**Anthemis Cotula*
**Erigeron strigosus*
Erigeron bonariensis
Eclipta alba
**Sonchus oleraceus*

The immigrants that appeared at the Goat Barn are fine examples of dissemination by means of unclean hay. The means by which they arrived is obvious. They were localized on a new manured clearing, off in the jungle, where they could and did pioneer, free from the competition of native plants and immigrants from other sources. Isolated and readily recognizable as a group, they were an inviting subject for study. Surprisingly, analysis of the colony showed that the species represented were not entirely those properly classed as weeds. Most numerous, to be sure, were the common itinerant aggressive weeds characteristic of fields, gardens, and roadsides in southern United States, where, with many of them adventive from the Old World, they are a readily recognized element in the flora. Present also, however, were members of the native flora of southern United States usually found away from cultivated areas or places much disturbed by man. These latter, represented by *Panicum, Eragrostis, Leptochloa* and *Erigeron*, are not weeds, but non-aggressive, widely distributed species in the native flora of that region. Weeds brought in by unclean hay are expected and usually readily recognized, but the other type of plant, appearing through the same means, could in southern United States, for example, be mistaken easily for the local representatives of the species indigenous to the region. This latter type is believed to have reached its wide distribution by slow spread over great lengths of time and by its own means of dispersal. The appearance of some of the type on San Jose, however, is convincing evidence that at least occasionally their seeds can be successfully transported to a distance along with agricultural products, either within the natural range of the species or sometimes far beyond it.

The ultimate fate of the immigrant species established at the Goat Barn is a subject worthy of speculation. Most of them are plants of temperate regions and some are practically restricted to the United States. On the new clearing on San Jose, however, they have displayed their ability to germinate seeds, grow well, flower, and even mature seeds under climatic conditions very different here in the tropic lowlands from that under which they usually occur. The mere ability to grow and reproduce, however, does not determine the natural range of a species. As with humans, plants have to make a living in a rigorous, competitive world. Only when they and their offspring can find, and most important, maintain, places to spread their leaves and so settle down for the manufacture of food, can the species represented persist in a new environment and become a permanent member of the com-

munity. The immigrants at the Goat Barn were presented with a new clearing for a home. Although a favorable situation, it was one that must change, since it could not remain long unshared. Tropical weeds will move in, and eventually the native vegetation can be expected to surge back and over the area. Thrown into full competition with local plants, the immigrants will then be given the real test of their ability to persist on the island. In this probably all will fail.

The lists of weeds given for the Camp area, the Navy Station, and the Goat Barn include all but seven of the total number known on the island by early 1946. Of those yet unmentioned, two were known from single stations; *Digitaria horizontalis* only about the Engineers' water pump and *Solanum nigrum* only at the roadside a half-mile south of the Cross Roads. The five other species were found at one or the other of two localities where the weed flora was sufficiently developed to deserve some comment. For some obscure reason a large number of introduced weedy plants became established on the large fill along Red Hill Grade. In April 1945 *Digitaria sanguinalis* was first found on the island there, and in the following May, among the earliest discoveries of *Echinochloa colonum*, *Fimbristylis annua* var. *diphylla* and *Fimbristylis miliacea* were found there also. Examination of the locality in January 1946 revealed them still present and associating not only with such other immigrants as *Cynadon*, *Ischaemum*, and *Blechum*, but also with two strangers, *Cyperus polystachyus* and *Phyllanthus Niruri*, neither otherwise known from the island. In an effort to explain this assemblage of weeds at Red Hill, I can only suggest that possibly they may be associated with some attempt to seed the fill, promote quick vegetation, and reduce erosion on the raw slope. Another center for new weeds was the Air Strip, and especially so the road along its south side. In January 1946 *Panicum fasciculatum*, *Trichachne insularis*, and *Physalis pubescens* were found only there. They were associating with a variety of the common introduced weeds of the island, of which *Digitaria sanguinalis* and *Echinochloa colonum* were the most abundant. Much of the earth-moving equipment used on the Air Strip was brought from the mainland, and possibly some seeds were transported with it. Otherwise the appearance of new weeds at the Air Strip (then still uncompleted) seems inexplicable.

By January 1946 a surprising number and variety of weeds had appeared on the island, but most of them were relatively localized in occurrence. *Cenchrus Brownii*, *Digitaria sanguinalis*, *Echinochloa*, and *Erigeron bonariensis* were the only ones that had become very aggressive. Colonies of one or more of them could be found here and there on roadsides in all parts of the island. The indications were that they would be ubiquitous roadside weeds within a very few years.

ECONOMIC PLANTS

Among all the plants growing naturally on San Jose there are very few that are particularly useful to man or especially affect his well-being. A Robinson Crusoe or Swiss Family Robinson on the island could rely on plants only for material for building houses or thatching shelters, for the plants provide no adequate source of food. A few plants have large fruits produced high above the ground, eaten by birds and seldom seen, while others have accessible small fruits, good for only a nibble. These might provide

an occasional dessert, but other than some few species that scratch, cut, prick, or poison the skin, they would be the only plants on the island of particular interest to the castaway, who, despite any possible inclination towards a vegetarian diet, would be forced to rely on the sea for food.

The few plants harmful to man on San Jose are no more numerous nor serious than those that can be encountered in the United States. The thorns of the Black Palm (*Bactris*) merit the same respect accorded those of cacti. The pungent, irritating hairs that coat the pods of *Mucuna* give the same kind of punishment as that delivered to the incautious by a prickly pear. The thorny leaves of the Wild Pineapple (*Aechmea magdalenae*) or the Piñuela (*Bromelia Karatas*) offer the same threat as a thrifty patch of blackberries. Saw-grass (*Scleria secans*) does cut the skin of the unwary, but who has not been cut by sharp-leaved grasses in the United States! *Cnidoscolus urens*, happily rare on San Jose, has painfully stinging hairs. Up north the familiar nettle has them also, though they are less serious in their effect. The milky juice of the Manchineel (*Hippomane*) produces dermatitis, but so does contact with Poison Ivy, Poison Oak, and Poison Sumac in the States. Of course, there are fruits on San Jose which should not be eaten, and there are plant juices which, if taken internally or splashed into the eye, would cause unpleasant or perhaps even very serious consequences. The careless person or indiscriminate nibbler is not safe from such plants in any part of the world.

The edible plants of San Jose are not a distinguished lot. Inferior and struggling plants of mango and banana grew at one place on the island when the Army arrived. At another place a few trees of sour orange were present. Coconut Palms, of course are plentiful on some beaches. In the forests of the island there are only a few edible fruits that are large enough for more than one bite. These are *Anona Spraguei, Anona purpurea, Licania platypus, Pouteria campechiana* and *Pouteria stipitata.* Their flavor is poor and they are not worth the effort usually required to obtain them. Although they may reach the size of a tennis ball or grow much larger, they are seldom seen. Most of them are borne high in trees, and as they mature are either eaten by birds or promptly devoured by wild pigs when they fall to the ground. The best wild fruits on the island, as well as those easiest to obtain in some abundance, are those of the Black Palm (*Bactris balanoides*), Wild Pineapple (*Aechmea magdalenae*) and Piñuela (*Bromelia Karatas*). Their flavor is acidulous and refreshing. The small yellow apple-like fruits of Nance (*Byrsonima crassifolia*) also have a pleasant flavor and frequently can be obtained in some abundance. The plum-like orange-colored fruits of the Jobo (*Spondias Mombin*) and the similar red ones of the Jocote (*Spondias purpurea*) are good in flavor and at times common. The small berries of *Coccoloba, Eugenia, Clidemia, Conostegia, Leandra,* and *Ardisia* offer nibbles for the not too finicky taste. So also do the seedy fruits of the Wild Guava (*Psidium*), the thin flesh surrounding the large stone of *Ximenia* and *Chrysobalanus*, and the pulp inside the dry fruits of *Inga* and *Guazuma.* The sweet fibrous pulp surrounding the seeds of the Nisparo (*Manilkara Chicle*) is liked by some. Edible nuts are negligible on San Jose. The Almendro (*Terminalia Catappa*) is apparently represented by only one small tree on the island. The nuts of the Wild Cashew (*Anacardium excelsum*) are said to be palatable when roasted, but difficulties in collecting them from the giant trees on

which they grow, especially before they are devoured by birds, make them practically unobtainable.

The forests of the island contain no trees with valuable woods such as Mahogany (*Swietenia*) or Cocobola (*Dalbergia retusa*). Very little marketable lumber could be cut on the island and none could be disposed of at a profit. The forests could, however, supply a variety of kinds of serviceable lumber for local consumption. Hard, heavy, durable wood in large timbers can be had from *Mora*, *Rhizophora*, and *Manilkara*. Good, fairly durable lumber for carpentry and general construction is available from *Phoebe*, *Andira*, *Tetragastris*, *Cedrella*, *Guarea*, *Bombax*, *Cassipourea*, *Cordia*, and *Tabebuia*. Woods suitable for furniture and cabinetry are to be had in *Cedrella*, *Tetragastris*, *Curatella*, *Cordia*, and *Tabebuia*.

Forest products other than lumber available on the island are not numerous nor important. The bark of *Curatella*, *Rhizophora*, *Conocarpus*, and *Laguncularia* is rich in tannin, and their woods are sources of superior grades of charcoal. Strong fibers are present in the bark of *Cecropia*, *Apeiba*, *Hibiscus*, *Ochroma*, *Bombax*, *Guazuma*, and *Cochliospermum*. Kapok is produced by *Ochroma* and *Bombax*. Rubber is produced by most plants with milky juice, but by no tree on the island in anything even approaching commercial quantities. From the latex of *Manilkara* an inferior grade of chicle is obtainable. Gums and resins are produced by *Pterocarpus*, *Bursera*, *Tetragastris*, *Protium*, *Clusia*, and *Zuelania*, but they have no value. Ethereal oils obtainable from the island representatives of the Lauraceae and Myrtaceae are similarly valueless. Other than the Coconut, the only plant producing appreciable amounts of vegetable oil is the Oil Palm (*Corozo oleifera*), but of this there are only a few plants on the island. Plants that have been used as soap substitutes are *Phytolacca* (root), *Gouania* (stem), and *Cissus* (stem). Those used by Indians as fish poisons are *Anacardium* (bark) and *Serjania* (stems). Soap plants and fish poisons are possible sources of rotenone, but the plants of these two kinds present on the island are not productive of this insecticide. No dyewoods are known here. No plant is a possible source of vegetable wax. There are a few scented flowers, but none are desirable for perfume. No plants of recognized medical worth are known on San Jose. There are no spices.

NATURAL HISTORY OF FOREST VEGETATION

In the tropics the continuous high temperature, abundant rains, and strong sunlight are extremely favorable for plant growth. Plants, both as species and as individuals trying to grow in each kind of situation, are so numerous that there is intense competition for root space and a place in the sun. The tropical forest has a much more complex make-up than the temperate forest. The plants in it, in response to competition, have assumed many specialized habits and forms which are peculiar to it.

FOREST FLOOR

The floor of the dense tropical forest is too shaded for abundant plant growth. Furthermore, the soil away from flood plains is usually rather poor. The heavy rains leach it, and the roots of the dominant vegetation impoverish it continuously. Fallen leaves rot quickly in the rainy season, and their

materials are absorbed in short order by the hungry network of roots just under the surface of the soil. Most of the ground is bare. Herbs are few and scattered and are represented for the most part by low-growing ferns, grasses, and sedges. Various saprophytes, the plant scavengers, may be conspicuous at times during the wet season. They lack chlorophyll and cannot make their own food, but do pick up a living, without the need of any sunlight, working over decaying vegetable material on the forest floor. Fungi are the common saprophytes, but on San Jose two slender little leafless herbs, relatives of the gentians, represent the group also. One, *Laiphaimos stenoloba,* has stems, branches, and flowers, all orange in color. It is rare. The other, *Laiphaimos simplex,* has a colorless, slender, simple stem about a decimeter tall bearing a single small blue flower. About October it appears suddenly in quantity, and its lovely little azure flowers can be seen peering up from leaf mold in many parts of the forest.

STRATA IN THE FOREST CANOPY

In the canopy of the forest plants struggle for a place in the sun. Trees reaching for the sunlight push their crowns upward on trunks. When numerous, their crowns are crowded, and the principal stratum of the forest canopy is formed. In the shade produced by these trees a few other kinds of trees and shrubs able to grow with less sunlight, such as *Ouratea, Calycolpus, Myrciaria, Eugenia, Ardisia,* and *Amaioua,* form a lower stratum or understory of herbage beneath the main canopy. Some of the island trees, like *Bombax, Anacardium, Didymopanax,* and *Manilkara,* habitually grow taller than the main canopy, and emerging above it here and there, overspread it. In some rain forests these highest trees may become very numerous and constitute the uppermost stratum of herbage in what is called a "three-story forest." The understory in some wet forests may have herbage dense enough to hide the main canopy from the observer on the ground. On San Jose the denser, mature forests generally have only very scattered emergent giant trees and an interrupted and not very dense understory. They are best described, accordingly, as "incompletely two-storied."

TREE TRUNKS

The tree trunks that surround the visitor to San Jose as he steps into a dense forest are generally rather different from those with which he was familiar in northern woods. The trunks may or may not be larger, but they display bark types and growth forms common only in the tropics. Most of them have a rather smooth tight bark that, when not moss-covered, is pallid from blotches of fungi and lichen. Rough, furrowed bark, so characteristic of northern forests, is not common. On San Jose such rough bark is found only in *Manilkara, Bombax, Cedrella, Spondias,* etc., trees for the most part characteristic of the dry Deciduous Forest. Coarse, flaky bark is even more rare and is commonly developed only by *Ternstroemia* and very old *Anacardium* and *Tetragastris.* Only two species on San Jose, *Phoebe Johnstonii* and *Pouteria campechiana,* sucker frequently and develop rough, knobby burls at the base of the trunk. The prevalence of relatively smooth bark is only one of the distinctive features of tropical tree trunks exhibited at San Jose. The trunk of *Bombax quinatum* is armed with numerous coarse thorns which

are conic in form, while that of *Zanthoxylum* has laminated pyramidal ones. The trunks of trees such as *Ficus* and *Pouteria* are usually very irregular in cross section, tend to be coarsely fluted, and frequently have deep, pocket-like recesses. The trunks of *Cecropia* are lifted well above the ground on a cluster of stilt roots. The ponderous trunks of giant arborescent mangroves (*Rhizophora*) also stand on stilts, but, in addition, are propped up above the base by heavy roots that take the form of flying buttresses. The forests of the island show many other examples of this interesting tropical development, trunk buttressing. In *Pelliciera* the buttressing is achieved by an ungainly, ponderous, conic thickening of the whole base of the trunk. Fine plank buttressing, propping of the trunk base by spreading wide plank-like outgrowths, is well developed by many individuals of *Ficus*, *Licania*, *Mora*, *Pterocarpus* and *Bombax*. Trees of *Ficus Dugandii*, found near Main Camp, give some magnificant displays of it. Other features in the forest may pass unnoticed, but a heavily buttressed tree seems to capture the attention of even the most unobservant. Since most buttressed trees are large and tall, generally overtopping surrounding vegetation, and accordingly exposed to the sweep of winds, the buttressing has generally been explained as an adaptation, a response to wind stress giving greater stability to the tree. Buttressing, however, may be present on trees sheltered from wind and commonly begins development on larger trees even before they reach a height where wind could operate as a factor. It is confined to certain species and related groups of species. Heredity, not local environment, controls it. Though it attracts much attention, it is, after all, only one of the numberless manifestations of peculiar growth form to be seen in the tropical forests, and like most of these to be accepted as merely exuberant, rather than purposive growth.

VINES AND THEIR ROLE IN THE FOREST

With the floor of the forest so shaded by arborescent plants that sunlight there is sufficient for only a few scattered shade-tolerant herbs, other plants must either clamber over the tops of the dominating trees or perch on their higher parts. Vines, or "lianas," as they are frequently called in the tropics, reaching the top of tke forest canopy, have plenty of sunlight and grow luxuriantly, frequently half smothering and so curbing the growth of the trees supporting them. Climbing plants are abundant and play an important role in tropical forests, especially in those of San Jose Island. They form curtains of growth on forest margins. They grow over and through the tops of trees to produce much of the density of the forest canopy. The cable-like, usually contorted stems of these vines, arising from the forest floor or hanging in great loops from the treetops, are well-known features inside the tropical forest. The profuse growth of vines affects the appearance of the forests as well as the environmental conditions within them. No account of such forests is complete without some discussion of the climbing plants.

Although the vines of the tropics are frequently thought of as contingent vegetation, a decorative garnish managing to exist on the outside of a sturdy growth of trees or shrubs, they are in fact an integral part of the forest community. In their struggle for root space and a place in the sunlight they are competing on equal terms with the trees. One may be impressed by massive trunks which support the crowded tops of the forest trees, but in

the cutthroat competition for a place in which to live, mere bulk in a plant is not a guarantee of success. Plants must expose their leaves to the sunlight for the manufacture of food. Of the leaves so exposed on the tops and sides of tropical forests, a large proportion frequently belongs to vines. The leafy tops of only a limited number of trees can be crowded into a forest canopy. In the forests of northern latitudes the trees compete among themselves for a place in the canopy and domination of the community. In the tropics vines are serious competitors of the trees and are involved in the struggle for sunlight. A tree has a fixed position and a rigid growth form, while a vine has greater freedom of growth. It has a form that allows it to be more of an opportunist. It can grow in various directions and, by rapid elongation of its stems, seize opportunities for a favorable display of its foliage, frequently to the detriment of trees supporting it. The slender vine, using its greater freedom of growth and its specialized climbing devices, might be said to have applied "science" and "speed" against the ponderous and stolid arborescent growth, which otherwise would dominate and be undisputed master in the vegetation of the tropics. One must not be deceived by the disparity of bulk displayed by trees and vines in the shady inner framework of the tropical forest. What one sees inside the forest is framework. For the plants whose stems are seen there the struggle for a livelihood goes on hidden from view in the soil below and in the canopy high above. Without any display of size in the forest shade, the vine can show as many leaves on top of the forest canopy and can be as successful a competitor for root space and a place in the sun as the tree growing with it. The slender, highly efficient stems of vines may supply a plant which in bulk of cellulose and in sheer weight may be the equal of the large tree rising with it. In the tropical forests trees and vines are peers. Together they make up the forest. He who walks through it seeing only trees sees only half the forest.

Tropical vines vary greatly as to size and duration. The important vines on San Jose are the woody, perennial, high-climbing ones, but several other types frequently also attract attention there. Noteworthy are the small, distinctly herbaceous sorts. These have very slender, somewhat wiry or rubbery stems that never climb very high and are frequently renewed each year. They grow vigorously at certain seasons, drape a small area of shrubbery or forest margin for a few months, and, after fruiting, die back, commonly clear to the ground. They are the type represented by *Dioscorea*, *Centrosema*, *Calapogonium*, *Rhynchosia*, *Phaseolus stenolobus*, *Galactia*, *Clitoria rubiginosa*, *Stigmaphyllon ellipticum*, *Dalechampia*, *Prestonia*, *Blepharodon*, *Funastrum*, *Merremia*, *Jacquemontia*, *Melothria*, and *Mikania micrantha*. Only occasionally do they attract attention in undisturbed areas, but in new growth that has sprung up along roads and on unused clearings they have become conspicuous at places because of their abundance. A few essentially herbaceous vines, however, become large in size, and some of them, though renewing all or most of their growth above ground each year, become conspicuous features in the forest at certain seasons. Examples are *Mucuna*, *Stigmaphyllon Lindenianum*, *Peltastes*, *Mandevilla*, *Cayaponia*, *Mikania cordifolia*, *M. Guaco*, and *M. leiostachys*. At the proper season their stems appear, grow with great rapidity, and may become very extensive within a few weeks, in most cases, probably, drawing on energy from the previous

season stored in special organs underground. *Cayaponia* is the most spectacular of these rapidly growing, short-lived, giant herbaceous vines. It develops main stems as much as 7 cm. in thickness and produces a huge smothering drapery over giant trees and extensive areas of thicket, but all this exuberant growth functions for only a few months and is produced anew each year from the ground up.

Tropical vines climb in a variety of ways, and some of them have developed very interesting devices that aid them in their ascent. One of the simpler types of climbing is used by the island species of *Monstera* and *Philodendron*. They represent what are generally called "root-climbers." The plant leans against and grows up along a tree trunk, clinging to the bark by clusters of rootlets that develop along the stem as it ascends towards the canopy of the forest. Another simple type of climbing, the one employed by most vines, is "scrambling." Some vines, such as the common *Connarus* on San Jose, rely solely on this method, others combine it with special climbing devices. The elongating shoot of the scrambler first leans upon the supporting vegetation, then weaves upward through it. As the shoot branches, the plant becomes interlocked with its support. Weaving in and out and continuing to branch, it becomes more and more firmly entangled in the supporting vegetation as it continues its ascent. Reaching the top of the canopy it spreads out, with its weight borne entirely by the tree which supports it. Its own stems may then become ladders for the climbing of other vines. Recurved thorns, on stems and frequently on leaves, may also serve scramblers as a supplementary aid in climbing. The thorns of *Acacia tenuifolia, Caesalpinia Bonduc, Machaerium purpurascens, Serjania nesites, Calonyction aculeatum*, and *Solanum lanceifolium*, and the hooks formed by the persisting hardened base of the leaf stalks in *Cordia ferruginea*, catch onto supporting vegetation and help affix the vines. Young plants of the *Machaerium* use their thorns with particular effectiveness. Their initial shoots can grow up along a tree trunk, held in place by specialized lateral branchlets that grow horizontally around the trunk and are hooked to it by the many sharp claw-like thorns they bear. Stiff reflexed hairs also aid in climbing. The minute abundant ones borne on the stems and leaves of the Saw-grass (*Scleria secans*) give very important help in the scrambling ascent of that plant.

Thus the root-climbers and the scramblers use simple but effective methods in reaching the treetops. Some vines, however, have developed very complicated devices to aid them in climbing. The "twiners" wind their stems, clockwise or counterclockwise according to the species, about their support as they grow upwards. Many of the woody vines such as *Dioclea* are twiners as young plants but become scramblers at maturity, with the twining habit persisting only in certain vigorous elongating shoots. The so-called "twig-climbers" are represented on the island by *Rourea glabra, Dalbergia Brownei, Securidaca diversifolia, Hippocratea volubilis, Elachyptera floribunda*, and *Hylenaea praecelsa*. In these plants young twigs may wrap themselves about a supporting branch, and after thus tying the plant with a hitch to its support, continue to thicken and elongate in a normal manner. The "tendril-climbers" are the most highly specialized types of vines. Their climbing device, the tendril, can be one of several kinds and may represent greatly modified branchlets, leaves, or parts of leaves. The "sensitive tendril" is a remarkable organ. When young it is straight and not at all coiled. As it

reaches out, it slowly swings in a circle and is capable of coiling about and becoming affixed to any branch or similar object it may touch. Among the island plants *Cissus, Vitis, Passiflora, Cayaponia,* and *Melothria* have sensitive tendrils that represent greatly modified and highly specialized branchlets. The sensitive tendrils of *Smilax, Entada, Adenocalymma, Amphilophium, Anemopaegma, Arrabidaea, Callichlamys, Cydista, Martinella, Phryganocydia, Pleonotoma,* and *Pseudocalymma,* however, represent specialized portions of a leaf. Most tendrils are relatively small, but huge whip-like coiling tendrils becoming a meter in length are developed from specialized shoots in *Omphalea panamensis.* "Claw tendrils" are developed in the island flora by *Macfadyena* only. In that plant they represent much modified and greatly specialized portions of a compound leaf. They are talon-like, hooking onto bark or grappling onto twigs, thus holding the plant to its support as it grows upward. Another device, the "hooked tendril," is developed by *Strychnos panamensis.* These are small, abruptly recurved structures, representing specialized branchlets, which hook over small supporting branches and then thicken and become permanently affixed to it, thus tying the plant to its support and so aiding in its climbing. The "hair-spring tendrils" developed by *Bauhinia, Serjania,* and *Gouania* are wiry tendrils, representing much modified branchlets, that develop at once a loose resilient coil at the apex which resembles the hair-spring of a clock in general appearance. The loose apical coil of the tendril is a grappling device. It becomes entangled or hooked about a twig and subsequently thickens and hardens and becomes permanently affixed to it.

The twining habit and the specialized devices by which the vines tie themselves to their supports are developed only on young plants and on the vigorous shoots of old ones. They rarely continue to function indefinitely. They serve the young plant as it struggles towards the treetops and on the top of the forest canopy they tie down young vine shoots which might be disturbed by wind before they have thickened and become woven into the supporting vegetation. If forced to bear weight for more than a few years they eventually fail. Many of the loops and contortions of vine stems to be seen in the forest were assumed when such holdfasts failed and sagging stems adjusted themselves to new points of suspension.

Vines are well equipped for climbing. In the thickets and along forest margins where numerous branches and existing vines offer support, they openly display their ability to climb up and spread out over the tops of bushes and trees. The methods, however, by which vines have reached to the top of the high canopy in the center of dense unbroken forest are less obvious. The leafless, usually contorted, cable-like stems of vines which writhe on the ground and then launch upward in an unsupported sweep into the treetops, frequently going through contortions en route, are features of the shady inner parts of the tropical forest. Unsupported, these stems could not have grown directly upward into the treetops, for when cut one part falls back to the ground while the remainder hangs down and sways like a stiff rope from the canopy. These stems are the trunks of the vines that grow over the treetops and display their leaves and flowers in the sunlight high above. These slender vine trunks cannot hold themselves erect. Naturally the question is raised, how can they possibly have reached the treetops in such numbers?

For most vines, like other plants, the floor of a dense tropical forest is a desert, an inhospitable place, not from lack of moisture, but from lack of sunlight. Seeds of the vines and trees whose herbage and branches make up the shading forest canopy rarely even germinate on the dark forest floor. Only a relatively few plants can make a living from the scanty light available there. On San Jose there are only a few vines that expose their leaves and live entirely within the forest shade. The twining fern, *Lygodium radiatum,* is frequent in the shade of South Forest. *Philodendron* and *Monstera* can expose their leaves in shady places and grow well. They are common in some forests, and, attaching their stems by rootlets, can grow up tree trunks and into the forest canopy. *Macfadyena* can start life in the forest shade and send up its slender stems to the canopy by clinging to trunks with rootlets and claw tendrils. *Connarus panamensis*, one of the most common climbers on the island, is a very adaptable plant and can grow in full sunlight or in forest shade. It is frequently present an an understory shrub inside shady forests, forming slender, erect, practically unbranched leaf-bearing shrubby growth as much as three meters tall. If, in their upward growth, the pole-like plants reach the support of overhanging branches or tangles of vine stems, they change their habit. Then they become scramblers and proceed to climb up into the canopy, and, upon reaching the sunlight, display no more leaves in the forest shade. The vines mentioned can start life within the dense shaded forest and have means of reaching the sunlight on the canopy. They are, however, the exceptions. Most vines of the forest got their start when conditions were very different from those prevailing in the forest today.

In order to understand the performance of vines within the forest, it is necessary to consider the history of the plant association of which they are a part. On San Jose most of the forest is of the type into which, by slow thickening and upward growth, the thickets of the island are being gradually transformed. Much of the forest has developed out of the thickety growth. The unusually fine display of vines on the island is one of the results. Many of the species of trees in the forest are present also in bushy form in the thickets, and growing over them are practically all the vines found in the canopy of the forests. As the thickets are transformed into forests, the stems of vines lengthen as the canopy on which they develop their leafy shoots and display their flowers is gradually elevated. In the older forests growth of new sun-loving plants is inhibited by the shade on the forest floor. Occasionally, however, the continuity of the canopy is broken by the fall of trees. The light then admitted into the forest is quickly followed by the appearance there of many seedling trees and vines. The canopy is closed again in a year or so, but during the sunny interim young vines have climbed broken branches and the dangling stems of torn vines. They have also rapidly draped growing young trees and have been lifted by their growth to reach the full sunlight of the forest canopy. The vines are not something added to the mature forest. They are a part of it. The vines have grown with the trees. The slender, cable-like vine stems may be as old as the trees supporting them, and indeed may even have risen sunward with them from the now shaded forest floor.

The stems that sprawl and writhe aimlessly on the floor of the forest, then soar aloft; the stems that descend from the treetops and then return

to them; the stems that are kinked, contorted, twisted, and almost tied into knots or abruptly go through helix-like spirals all reveal a story. The sinuous stems may have been shaped as the young plant worked its way, now this way, now that, upward through dense growth now gone, or twined about branches long ago disappeared. The kinks and snarls may have been formed long ago when these stems were climbing in repeatedly slumping masses of vines, curtaining what was then an opening in the forest or perhaps even the former margin of the forest itself. The stems that hang in loops from the canopy or trail on the ground tell of other changes that have gone on. The support of the stems changed as they grew in size and weight. They have slumped and shifted and assumed new contortions in accommodation to changing points of suspension. The behavior of vine stems seen in the forest is not aimless, chaotic growth nor extravagant caprice. These stems were shaped in their youthful struggle upward, and in maturity by the continuous readjustments to changing support in the ever-changing growth of the forest. From the bizarre form and behavior of vine stems one can decipher much of the history of the forest community. No other element in it begins to tell so much nor does it so dramatically.

The stems of vines are interesting for their form and structure as well as for their behavior. In many tropical vines the stems assume unusual form as they increase in size. Some become ribbon-like; others are excessively irregular in cross section. Many are symmetrical but thicken in such a way that their cross sections are distinctive in shape, being elliptic, triangular, square, X-shaped, etc. Some by very unusual growth take on the appearance of compound structures, and at times seem to be made up of a number of entwined stems, suggestive of a very coarse rope in outward appearance and in inner structure. Many of these more conspicuous peculiarities of vine stems are associated with anomalous behavior of the phloem. In the great majority of ligneous plants this is usually inconspicuous tissue, well developed only between the bark and the woody cylindrical mass of the stem. In many vines the phloem is normal in behavior, but in some it may be present, not only inside the bark, but also scattered in evident concentric bands in the wood, or, in others, form conspicuous wedges that appear to intrude into the wood in definite patterns. In still other cases it may even seem to isolate sections of the wood and so give their stems the appearance of compound structures. The conventional, more or less cylindrical stem-form is maintained by most vines on San Jose. Apparently compound stems are exhibited there only by the several species of *Serjania*, and best in the markedly three-sided stems of *S. rhombea*. Stems with concentric bands of phloem distributed in the wood are developed only by old plants of *Machaerium purpurascens*, *Securidaca diversifolia*, and *Dolicarpus dentatus*. Good examples of phloem wedges are to be seen in the large old stems of the island's viny *Bignoniaceae*, especially in the square ones of *Pleonotoma*. Stems distinctly elliptic in section are developed by *Entada Gigas*. They are the result of an unusual type of unilateral thickening which, incidentally, is also the cause of their peculiar type of bizarre contortions. The island species of *Bauhinia* (Plate 6) puts on a spectacular display of ribbon-like stems. Such stems of *Bauhinia* are known as "monkey ladders" and form one of the well-known features of the forests of the American tropics. The young stems of *Bauhinia* are circular in cross section, but as their length in-

creases they grow in size, not by symmetrical enlargement in diameter as most plants do, but by lateral outgrowth along opposing sides of the stem. As a result a high-climbing elongate stem may be a few centimeters wide and only a few millimeters in thickness. Such stems become very sinuous and in their regular curving back and forth become concave on the inside and convex on the outside of each curve. This undulating form, with alternations of convex and concave surfaces, may become accentuated or obscured as the stems grow further in breadth and thickness. In some straight sections of old stems, 1.5–2 dm. wide and 0.5 dm. thick, it may persist only as a series of coarse depressions that decorate the sides of these great ribbons of wood.

Vine stems are more than bizarre in behavior and unusual in organization. They are the slender trunks of plants that may have many branches totaling hundreds of feet in combined length. The foliage they display, exposed on top of the canopy and transpiring great quantities of water daily, may equal in total surface that of the largest trees. It is as a cable-like, highly efficient transport organ that vine stems are really most remarkable. They can deliver as much water to the canopy as a tree trunk many times bigger in girth. Their conductive vessels are usually more efficient and generally larger in diameter than those found in other kinds of plants. Noticeable quantities of water rarely drain from a detached section of tree trunk, but they frequently do from sections of vine stems. In extreme cases the quantity may be considerable, vessels in a stem section a meter in length quickly yielding as much as a tumblerful. Indeed, stems of certain vines can serve as a safe emergency source of drinking water in the forest and have been termed "water vines" because of it. On San Jose the stems of *Tetracera* can usually be counted upon to perform this role, though it is doubtful if the quality of drink supplied is worth the acrobatics with a machete which are necessary to get it. It is to be noted, however, that the distinctive behavior of water vines is not the result of their carrying peculiarly large quantities of water. Vine stems of many other kinds contain as much water and transport quantities as rapidly. The vessels in the cut section of a water vine, for some reason, simply drain much more rapidly than those of other vines. Judged with proper perspective, the gush of water from a cut water vine becomes a dramatic demonstration of the quantities of water that can be contained in and that are constantly in movement up the slender stems of all vines. In their primary function, transport of water and food solutions, the vine stem does an efficient job, and what is more, does it with a slender form, combining flexibility and great tensile strength which allow it to make endless spatial adjustments in the forests and so maintain unbroken the connection it forms between the vine's roots in the soil and the great leafy branches on top of the canopy. Without breaking it is able to bend and give when trees supporting it sway in the wind. When the weakening of old supports causes it to fall, it can adjust itself to new points of suspension and shifted centers of load. Where a tree has adapted the mechanical principles of the column, the vine has adapted those of the cable. Similarities to the cable are not restricted to outward form. Vine stems in cross section, not only in respect to outline but also in respect to the organization of their woody body, reveal patterns recognizable as conforming with those established by engineers as combining flexibility and tensile

strength with economy of material. The vine stem in plan and function is a remarkable demonstration of Nature's engineering.

EPIPHYTES

In the tropics numerous plants root and grow, not in the soil of the forest, but high above the ground in the framework of the forest. By perching on branches or growing on the trunks of trees they can get some direct sunlight or at least the full benefit of that which filters through the canopy. Dust accumulated in the fissures of bark, and perhaps some manure from birds, provide their minimum mineral requirements. Their water comes from the sky, either directly or by drainage down wet branches and trunks after storms. They are a distinctive element in the tropical forest and are known as "epiphytes." They use other larger plants simply for a place on which to grow and steal no food or water from them, as do the "parasites." On San Jose the flowering plants are represented by only one parasite, *Struthanthus orbicularis*, a slender-stemmed viny mistletoe which forms tangled masses on thickets and forest canopy. There are, however, numerous epiphytes. Most of them are herbs, but a few attain large size and some are even trees. They are to be seen clinging here and there on tree trunks, or making gardens on large tree branches, or producing masses of woody growth that can crowd and even handicap the leafy branches of the tree supporting them. Epiphytes in variety and abundance reach their maximum development in those parts of the tropics where atmospheric humidity remains near saturation. Climatic conditions on San Jose are suitable for only a relatively moderate display of them. On the island, indeed, they are found in conspicuous abundance only on giant trees of *Anacardium* in streamside forests and on some large individuals of *Bombax quinatum* in deciduous forest.

Other than mosses and hepatics, the common epiphytes on San Jose are the ferns and various orchids. There are a dozen common epiphytic ferns on the island, *Trichomanes punctatum, Elaphoglossum piloselloides, Vittaria lineata, Ananthacorus angustifolius, Asplenium serratum, Polypodium costaricensis, P. Kuhnii, P. occultum, P. percussum, P. polypodioides, P. xalapensis*, and *Dryopteris patula*. Only a few of these are conventional in appearance. Most of them, including the largest, the Birdnest Fern, *Asplenium serratum*, are unlike the common northern ferns in having simple elongate unlobed fronds. The *Vittaria*, indeed, most resembles a hanging clump of grass leaves. The orchids present include most of the species of the group known from the island but are not a distinguished lot. Only *Sobralia* and the less common species of *Oncidium* are notable for beauty of blossoms. Most of the species, as in other parts of the tropics, have small and frequently unattractive flowers, and, furthermore, the plants themselves may be small and very unobtrusive.

An epiphytic cactus, *Cereus costaricensis*, is well developed on some trees. The presence of a cactus among the epiphytes is not surprising. All epiphytes must be plants able to withstand periods of drought, for though thoroughly soaked when it rains, they live in exposed places without soil moisture to draw upon, and so can become excessively dry in rainless periods. The conditions are rather similar to those on top of bare exposed rocks, a type of place on which the cactus and occasional congregations of other epiphytes also

occur. Most epiphytes are well adapted for their rigorous habitat. They have thickish leaves resistant to drying, and many have thickened stems of other structures suitable for water storage. Most of them go into a resting state, while many shed their leaves and die back during the rainless months.

Probably the most conspicuous epiphyte on San Jose is *Vriesia sanguinolenta*. It is found on mangroves in coastal swamps and on various trees in the forest, but its large clusters of pale green leaves are most common and conspicuous on giant trees of *Anacardium*. Its broad but elongate ascending leaves, 6–9 dm. long, are tightly clasped together at the base, forming a reservoir in which rainwater is collected and retained during the wet season. In some parts of the tropics similar epiphytes, relatives of this *Vriesia*, are very numerous, and a large variety of insects and even tree frogs and some aquatic plants regularly live in the water they collect. In some places, because they serve as breeding-places for disease-carrying mosquitoes, they have had to be systematically destroyed. Examination of the island *Vriesia* and its similarly water-collecting but less common and conspicuous associate *Tillandsia fasciculata* seemed to indicate that they served as homes for only a few unimportant aquatic insects. As has been reported for other members of its group, the water collected by living plants of *Vriesia* always seems to remain fresh and potable.

Two interesting modifications of the ordinary epiphytic habit are represented on San José. Earthen ant nests located in treetops offer a source of food and a place in the sun for a few special plants. On the island two plants grow only on these nests. They are *Epidendron imatophyllum*, an orchid with an attractive raceme of small purple flowers, and *Codonanthe decurrens*, a small fleshy plant with opposite leaves and elongate, very irregular white flowers. Where the nests occur one or both of the species are usually present. Another variation in the epiphytic habit is found in a number of woody plants that regularly begin life high in trees. Their seeds germinate on branches of the host, and the young plants get established there, eventually sending roots down along the trunk of the host. The young plant at first grows slowly. Having plenty of sunlight, it begins rapid growth when its roots reach the ground and a water supply is established. More roots are sent down, and branches are developed that at least handicap, if they do not actually crowd out, those of the host. Plants of this type, such as *Clusia*, *Souroubea*, and *Drymonia* become a considerable nuisance to their host but never kill it as do *Coussapoa* and some species of *Ficus*. These latter frequently send down many roots which can encase and strangle the trunk of the host. As the latter dies the strangler, now supported by its own trunk of roots, fills up with its own branches the space vacated in the forest canopy. These woody plants that begin life on limbs of trees are commonly well developed on giant specimens of *Anacardium*. Their leafy branches are usually to be seen intermingling with those of that tree, and their large descending roots are common encumbrances on its trunks. Though frequently victimized, the *Anacardium* is rarely mastered. Other sorts of trees, however, are less fortunate. Walking through any stretch of forest, examples of *Coussapoa* and *Ficus* are to be seen in their many roles from benign little epiphytes through ruthless stranglers to stately trees that retain no evidences of their cutthroat past.

ANT PLANTS

Many trees in the tropics are always associated with certain ants which make their homes inside or upon the plant. Some of these plants have peculiar structures so favorable to ants that they have been interpreted as special adaptations for that purpose, the assumption being that by attracting ants the plants gain from the protection which the swarms of these insects provide. Although not showing such spectacular structures as some found elsewhere in the tropics, as, for example, in the Bull Horn Acacia of the Isthmus, the "Ant Plants" or "myrmecophytes" of San Jose deserve attention.

The epiphytic *Ficus panamensis* always bears earthen ant nests in unusual numbers. The twigs of this fig are grouped and radiate at intervals along the branches in a manner offering perfect support for the nests. Among the radiating twigs the branch also produces short, stiff, divergent, nail-like adventitious roots. These probably add to the support of the nests, which are usually globular and a couple of decimeters in diameter, and very likely also tap the source of organic plant food presented in them. The common Guarumo (*Cecropia*) is a famous example of ant plant. Its trunk and branches contain a series of natural cavities which are almost invariably, even in seedling plants, occupied by ants. On each internode of the stem, fibers separate at one point and the stem walls are thin. A minute circle marks this spot on the outside of the twig, and through it the ants always gnaw their entrance into the hollow interior of the stem. Scale insects that yield honey-like secretions are placed by the ants on the walls of the cavities and are tended by them. Although the scale insects supplying food to the ants must represent some drain on the energy of the *Cecropia*, many species of the genus, though not the San Jose one, actually seem to encourage the ants by supplying them with a special sort of nourishment. At the base of the leaf stalk they develop a small cushion that continuously sprouts tiny protein-containing bodies which are eagerly sought by the ants. In *Cordia alliodora* the twigs and branches are enlarged and hollow at intervals. The cavities provided are practically always inhabited by ants and the scale insects they tend, but the plant appears to receive nothing from its guests. It gets little protection, for an unusually large number of leaf-eating and juice-sucking insects are reported as attacking it. A somewhat similar one-sided relationship seems to exist in the case of *Lonchocarpus pentaphyllus*, a tree in which the twigs and larger branches are tunneled and inhabited by ants in swarms. Anyone who collects orchid plants from the trees soon finds that some kinds are always associated with ants. For example, they always swarm over plants of *Sobralia panamensis* when they are disturbed, since there always seems to be a large nest tucked away among its mass of roots. The plants appear to have no definite adaptation specially favoring the insect and it is possible that as they grow in size they simply provide a protected place among their roots that can be utilized by the ants. At most, the plant may get some accessible organic food as a result of the relationship. One orchid, *Epidendrum imatophyllum*, however, gets started only on earthen ant nests, grows only on them, and occurs practically wherever they are present. Possibly its roots may help bind the nest together and so benefit the ants, but otherwise the plant seems to gain most from the relationship, since it has not only access to organic material but also a stable site for growth in the

sunlight high up in the forest canopy or even on top of it. A home for ants is provided by only one of the San Jose orchids, *Diacrium bilamellatum*, whose dense ball-like clusters of stout thick stems are common features on trees along the coast. Ants gnaw an entrance into its stout hollow stems and use them for nests. The plant's relationship with the insect is much the same as that already observed in *Cecropia* and *Cordia*.

DISPLAY OF FLOWERS

Many persons visiting the tropics for the first time are disappointed by the lack of flower display to be seen in the forest. The abundance of flowers and the riot of color they expect are confined to tropical gardens. Most of the forest plants have flowers that are small and inconspicuous. Each of the species has its particular flowering season, usually lasting two or three weeks, and only rarely are more than a few very conspicuous blooms on display simultaneously. Furthermore, much of the flowering is on the top of the forest canopy and not ordinarily visible. However, although perhaps not in the quantity some visitors seem to expect, there are plenty of flowers to be seen on San Jose at all seasons. Part of these, to be sure, may be small and of interest chiefly to a botanist, but there are always many that attract attention because of their show of color. Many of these latter put on only a modest display here and there, and only those who pause can enjoy them. Others may give touches of color to large areas of thicket and forest. And a few give such a splash of color to the landscape that they can not be overlooked by anyone. They become dominant features in parts of the island during their season and bring comment from the most unfeeling or preoccupied.

The more conspicuous flowers are seasonal and are restricted to a limited number of species. Many of these are vines. During the dry season *Securidaca diversifolia*, *Arrabidaea pachycalyx*, and *Cydista heterophylla* at various times produce magnificent massings of pink in the treetops. Notable displays of yellow are given by *Combretum secundum* and *Callichlamys latifolia*. The yellow flowers of *Merremia umbellata* are conspicuous in second growth. *Fischeria* and several species of *Mikania* garland forest borders with white, and in places the vermilion thistle-like heads of *Lycoseris latifolia* make a nice show in thicket. For a time during the rainy season the red flower clusters of *Cissus* make a lovely pattern over the curtain on forest margins, and here and there in the thicket the pink flowers of *Arrabidaea Chica* and the purple spikes of *Dioclea* attract the attention. The high-climbing vine *Phryganocydia corymbosa*, however, is the showy one of the wet months. It covers isolated trees and areas on forest margins with a profusion of large pink flowers after each storm. No one fails to notice it.

Only two species of trees put on a really spectacular show, both of them during the dry season. *Tabebuia pentaphylla* becomes literally a mass of pink, its then usually leafless crown bearing clusters of large pink flowers in incredible profusion. It occurs as scattered emergent trees in thicket and displays its glory for all to see. The evergreen, *Macrocnemum glabrescens*, is also a lovely sight in flower, but grows in dense streamside forest and is seldom seen. During February its dark green crown is enlivened by numberless large clusters of dark pink flowers. At the proper season there are a few places where one can look down over streamside forest and see many of the gaily-colored tops of the tree, but only along Red Hill Grade is the

beauty of the decorated tree adequately seen close at hand. Only a few other tree species have flowers that attract much attention during the dry season. *Cordia alliodora* is for a short period a snowy mass of white. For a few weeks the rare trees of *Jacaranda* draw attention by their great clusters of purple flowers. The two island species of *Bombax* bear great numbers of white flowers on practically bare branches and so attract some notice. Generally, however, only after they have fallen to the ground, turned brown, and accumulated in inordinate numbers under the tree do the flowers of *Bombax* really become conspicuous. Early in the rainy season *Luehea candida* produces its large white flowers in great numbers and is conspicuous for a time. *Gustavia superba* blossoms abundantly a little later. Its pink flowers, 8–10 cm. broad, are the largest and also one of the most delicately scented on the island. They are borne on a tree of unusual form and exposed in great numbers along the branches below the leaf clusters, and hence always attract the eye. During most of the wet season the shrub *Isertia Haenkeana* is a notable and extremely decorative element in thickets because of its many large handsome red and yellow flower clusters. *Plumeria,* an ungainly shrub growing on thin soil along the sea, produces its handsome clusters of very fragrant white flowers practically throughout the wet season. *Pithecollobium rufescens*, a common tree in the forests, is covered with hundreds of yellowish balls of stamens late in the dry season, but becomes most noticeable late in the wet season when its somewhat fleshy, very contorted red pods are matured in great numbers, making a showy display because of their color and abundance.

Most herbaceous plants flower during the wet season. Early in the season the white flowers of the Spider Lily (*Pancratium*) attract attention on the beaches. As the season advances various small wild flowers, because of numbers and massing, make displays at places in the grassland and on areas of thin soil. Late in the season the flowering and fruiting begonias become very noticeable and put on quite a display in some wet shady places. The cacti all flower in the wet season, some having very large and handsome blossoms.

Orchids of one kind or another are in flower during all months of the year. Most of them have small inconspicuous flowers and to the average person show little resemblance to the aristocratic and lush relatives to be seen in northern greenhouses. Only one island species, *Sobralia panamensis*, suggests a "real orchid." This is a common epiphyte and has lax, leafy, somewhat bamboo-like stems five to ten decimeters long and a rather attractive delicate pink and purple corolla about eight centimeters long. It seems to flower mostly during the latter part of the year. *Oncidium panamensis*, with a large loose inflorescence of many small spotted yellow flowers, is more attractive but much less common and flowers less frequently. The best known orchid on the island is *Brassavola nodosa* (Dama de noche, or Queen of the Night). It has white flowers fragrant only at night. The plant is extremely abundant on bare rocks along the coast and is in constant and abundant flower during the wet season.

CHARACTERISTICS OF TROPICAL FOLIAGE

The foliage of the tropical forest is distinctive in a number of ways. It is very dense and prevailingly dark green. Leaves with toothed margins and sharp lobings are notably very much less common than in northern forests.

Trees with compound leaves, in which the leaf stalk bears numbers of leaflets rather than a simple blade, are proportionately much more common. The leaves of the dominant vegetation rarely have hairy surfaces. In the northern forests a great variety of well-marked leaf forms permits quick recognition of most kinds of trees. In the tropical forest most of the trees and vines have leaves of a generally very similar form, and their differences are not instantly apparent.

FALL AND RENEWAL OF LEAVES

Though most of the trees on San Jose are evergreen, they do not hold their leaves indefinitely. Each of the numerous kinds, at its particular season, annually renews all or at least a part of its foliage. During the dry season there is a perceptible thinning of the canopy of evergreen forests and a notable accumulation of fallen leaves on the forest floor. The majority of trees in the forests are shedding leaves and at the same time quickly replacing them, but usually in slightly reduced quantities. A conspicuous reduction in leafy covering occurs on the scattered individuals of *Cecropia* and *Didymopanax*. By March they have cast most of their foliage and have produced only sparse, mostly incompletely developed new leaves. They are half clad and very unkempt in appearance and so continue through the remainder of the dry season. In the evergreen forest only occasional trees, usually *Bombax,* are ever entirely leafless. In thickets only the scattered emergent trees of *Tabebuia* and *Zuelania* remain leafless for any length of time. In the Deciduous Forest, however, practically all trees and shrubs are devoid of leaves during the dry months. That type of forest in the rainless season is reminiscent of northern forest in its barest winter condition. With the advent of each new rainy season the maximum leafy cover is resumed by all trees, both in deciduous and in evergreen forests.

In the evergreen forest most of the trees shed and renew their foliage without attracting much attention. At their particular period, usually sometime during the dry season, trees of a given species everywhere in the forests will grow new leaves and unfold them as all or a definite part of the old ones are dropped. This process may be completed by the individual in a matter of one or two weeks, or it can be variously prolonged up to several months, but always with a pattern and at a period characteristic of the species. As only scattered trees and usually only parts of them may be affected at a given time, the density of the forest canopy is never conspicuously altered by the change. A common tree in the forest may renew its leaves and one may notice it only when its old leaves suddenly accumulate on the forest floor or a temporary freshness of green gives it slight individuality when seen along some forest margin. Only a few of the trees in evergreen forest have leaves which become conspicuously colored before falling. Those of *Mora* make a fine display of yellow and those of *Byrsonima* and *Ficus Campbellii* of maroon, while a noteworthy show of crimson is given by *Nectandra*. With most species, however, the leaves either turn brownish or fade to pale greenish or at most become somewhat yellowish before falling, and as a result attract little attention. The new foliage in most cases is distinctive only for its freshness of green, but on San Jose, as in other parts of the tropics, that on a few species is notable for beauty and conspicuous coloring. The new foliage of *Licania*, indeed, gives one of the most magnificent displays of

color to be seen on the island. Red in color it turns whole valleys aflame for a time during the dry season. Conspicuous at times, though never spectacular, are also the new red leaves of *Tetragastris* and *Ouratea* and the unfolding crimson ones of *Gustavia*.

Among the trees of the Deciduous Forest, leaf fall and renewal follows a very different pattern than that observed in the dominating evergreen forests. Most of its trees and shrubs drop all or most of their leaves during December and January and do not renew them until the rains begin at the end of the dry season in Many or June. One species, *Bombax quinatum*, actually begins shedding foliage in November or even in October, well before the rainy season is concluded, and is entirely leafless by mid-December. Thus it stands bare for about six months out of the year, during that period showing signs of life only by abundant flowering in January or February. Many of the trees of the Deciduous Forest are ripening fruit as the dry season begins, and some begin flowering before it is over, but for most it is a resting period. The conspicuous exceptions are *Bombax* and *Cochliospermum*, which flower and fruit abundantly while naked, and *Spondias*, which, though shedding all its leaves by January, remains leafless for only about a month and then re-leaves and goes into abundant flowering before the season is two-thirds over.

Woody vines behave in a manner similar to the trees with which they associate. Those in Deciduous Forest tend to lose their leaves early in the dry season and have their period of re-leafing and vigorous growth at the beginning of the wet season. For vines in the evergreen forest, on the other hand, the dry season is the period of vigorous growth. The elongating, tendril-bearing or twining shoots of the common vines, groping out in great numbers from forest margins, are conspicuous during this period. Most of their climbing, as well as their leaf renewal, takes place at this time.

If we exclude from consideration the Deciduous Forest, since, after all, it occupies only a small fraction of the island, we can say in general terms that the trees, shrubs, and woody vine of San Jose do most of their vigorous growth and leaf renewal sometime during the dry season. At the beginning of the wet season they thicken up their foliage, but during most of the rainy months they behave like trees in the northern forests during midsummer, hardening up new wood, consolidating gains, and apparently devoting much of their energy to the manufacture and storage of food. Flowering and fruiting may be confined to one or the other of the two periods or shared between them in varying ways, being fitted into the annual rhythm of growth in a pattern characteristic of each species.

FRUITS AND SEEDS IN BEACH DRIFT

Some of the beaches of San Jose are notable for the masses of drift accumulating upon them. This drift is rich in a great variety of botanical objects, mostly seeds and fruits, some of which, such as the sea beans, are so attractive that they are usually among the first souvenirs pocketed by the casual visitor to the shore. When studied, this miscellaneous assortment of things washed up by the sea proves to be of considerable interest and certainly one of the very fascinating aspects of tropical natural history.

Many of the seeds and fruits cast up on the beach are suitable for dissemination by ocean currents. They are the means by which a number of species have achieved a very wide distribution in the tropical lowlands. Those reg-

ularly found on the beach in a viable condition, and these include some of the commonest sorts, are the products of plants which either grow only on the beach or close to it, or at least can get established there before spreading further inland. These seeds and fruits may be shed actually onto the beach within reach of the tides or storm water, or they may be dropped inland, reaching the sea only after having been washed into some stream. These buoyant seeds and fruits, the spark within them shielded by stout, impervious walls, are perfectly fitted for the long immersions, the rough treatment in the surf, and the spells of alternate soaking in sea water and baking on the hot sand that is their fate as playthings of the sea. Sometimes stranded and at times carried out to sea and swept along by currents, they have a gypsy existence. Found in the drift today they may be only temporarily beached during a voyage that may have been going on for years and with further interruptions may continue for years more. Under normal conditions their germination, if it is fated to occur, may be delayed for long periods, months or even years, and at length proceeds only when they are thrown up by storms above high-tide levels on shores at great distances from that on which grew the mother plant. The coconut, sealed in its thick husk, is a well-known drift fruit of this class. Those corky balls, the wave-worn fruit of the Manchineel (*Hippomane*), PLATE 11, FIG. 2, extremely abundant in the drift at San Jose, furnish another example. The sea beans, large, plump, flinty seeds of *Entada*, *Dioclea*, and *Mucuna*, and also the nickernuts, seeds of *Caesalpinia*, are well-known members of the class, see PLATE 8. The ability of such strand fruits to retain vitality for extended periods in the drift and to travel long distances in currents is well established in fact. Many of them originating in the Caribbean, for example, have been carried by the Gulf Stream and eventually picked up in Iceland, Spitzbergen, Norway, Ireland, and even in northern France. Even on San Jose one can frequently find seeds and fruits with encrustations of bryozoans that could only have been acquired after many months of floating in the ocean. Sea beans originally picked up on a tropical beach have been germinated after fifteen years of storage in a museum. It is believed that under favorable conditions many of these hard ocean-borne seeds can retain vitality for over a century. They apparently can remain in resting state almost indefinitely if the thick coats or tough fruit walls protecting them remain impervious to moisture. When planted, however, sea beans, for example, will proceed to germinate rather promptly if their coat is first made permeable by sandpapering or by notching with file or knife. Under natural conditions, on the other hand, prolonged exposures to alternations of sea and sun or the slow attack of soil organisms may crack or etch their coat, admit water, and cause germination. If this happens in a suitable place, the new plant gets established. As with the individual seeds of most plants the chances for successful germination and further growth of a particular ocean-borne seed is extremely remote. However, over thousands of years incredible numbers of such seeds have been launched each year. Only a few need complete a voyage and germinate in order to establish and maintain colonies of the species on beaches and in coastal thickets on scattered islands and along lengths of mainland coasts.

For the fruits and seeds of beach plants, stranding in the moist sunbaked drift on the beach may be only an interruption in leisurely travel, but for

the seeds and fruits of swamp plants it is usually the disastrous conclusion of a voyage. Plants of the muddy coastal swamp forests generally have very poorly protected seeds and fruits that germinate soon after, and in many cases actually before they are dropped into the tidal waters that bear them off. Showing many adaptations for their kind of ocean dispersal, they can float for considerable time and be carried long distances by favoring ocean currents. If eventually floated into a tidal marsh or estuary by advancing tides, they may perhaps become lodged there, root in the mud, and even grow to mature plants. Many, however, are fated to be washed up on sandy or rocky shores, to be bruised and battered in the surf, and to be cast up broken to die on the inhospitable beach. The wrecks of these sea-borne fruits and seeds of swamp plants may accordingly be a conspicuous element in the beach drift. On San Jose great numbers of the large germinating seeds of the swamp trees *Mora* and *Pelliciera* reach this disastrous end. During November many of them are afloat in Bodega Bay, but along the beaches, where they become very conspicuous objects, many are to be seen thrown up on the sand or being mercilessly mauled in the surf. The stick-like seedlings that are the reproductive bodies set free by *Rhizophora* frequently also come to an unhappy end in the beach drift. Dead, or bruised and dying, they can be found there most of the year, but probably most abundantly at the close of the rainy season. In places they may accumulate in great numbers, and at times, like piles of sticks, form windrows high on the beach.

In considering the fruits and seeds of ocean-disseminated species present in the drift, one is conscious of the adaptations fitting them for playthings of the sea, of the prodigality with which they are cast to the waves, and of the romantic uncertainties of their destiny. The other fruits and seeds in the drift, parts of the buoyant rubbish collected by streams and finally cast up on the beach, tend, however, to shift attention to the origin and nature of the drift as a whole. Although these fruits and seeds from inland sources may occur in considerable number and variety in the drift, most of them are not at home there. They are not fitted for ocean dissemination. Most of them are dead or moribund, sufferers from immersion or from the effects of salt water. Deteriorating relatively slowly, only a very few can retain vitality for a week or two, or at most for several months under drift conditions. Many of the fruiting bodies of this general class, furthermore, reach the beach without any matured seeds at all; those which have been shed immature or only after their seeds have been freed. Dumped there on the beach these rubbish fruits and seeds in the river sweepings are found in various states of preservation. Varying according to age they may be firm, mere shells, or only fragments, and they may be fresh, worn, or decayed, be living, dead, or dying. Some become blanched, buoyant skeletons and persisting conspicuous objects in the shifting drift, but most are doomed to rot and disintegrate. All, however, prove of some interest when identified, and some are among the most exciting objects to be found in the drift.

Among the drift on San Jose, many of the dead or dying seeds and fruits from inland sources may be readily identified as the products of species common in the interior of the island. Noted repeatedly were those produced by *Bactris, Ficus, Cnestidium, Connarus, Andira, Tetragastris, Cedrella, Guarea, Pera, Apeiba, Luehea, Bombax, Guazuma, Ternstroemia, Cochlospermum, Gustavia, Pouteria, Manilkara,* and *Stemmadenia,* some present

sparingly but others in moderate quantity. With these possibly locally derived fruiting structures in the drift, however, there were a goodly number of strange ones which could not have originated on the island. These clearly must have reached San Jose as part of the drift swept in from the open sea. As alien objects, indicative of a foreign element in the drift, they deserve special attention. Those which have been identified* may be listed, with a few pertinent facts, as follows:

Astrocaryum sp. Black stones of fruit common in the drift. Possibly derived from a wide area. PLATE 9, FIG. 4.

Manicaria saccifera. Seeds, some living, many dead shells, frequent in the drift. Source doubtful, but because of freshness of some examples, perhaps on some of the Perlas Islands. The species, surprisingly, has not even been reported from the Pacific side of America. PLATE 9, FIG. 3.

Phytelephas sp. Seeds, represented by buoyant empty shells, frequent in the drift. Possibly derived from the islands and shore of the Gulf of Panama or even from the coast of Colombia. PLATE 11, FIG. 1.

Abuta sp. Dead fruits occasional in drift. Most likely Colombian in origin. PLATE 10, FIG. 4.

Prioria copaifera. Pods with dead seeds frequent in the drift. Possibly derived from a wide area. PLATE 12, FIG. 2.

Sacoglottis sp. Dead fruits occasional in drift. Most likely Colombian in origin. Product of an unnamed species belonging to a genus previously unreported from the Pacific side of America. PLATE 10, FIG. 3.

Mangifera indica. Dead, clean seeds occasional in drift. Possibly originating on adjacent islands or in refuse from ships or the mainland coast.

Calatola sp. Dead, empty stones of the fruit occasional in drift. Origin doubtful but probably Colombian. PLATE 10, FIG. 1–2.

Sterculia apetala. One woody pod with dead seeds found in drift. Product of a tree common on the mainland and possibly present on the Perlas Islands also.

Lecythis sp. A dozen woody fruit cups found in the drift. The product of no known Panamanian species and possibly of Colombian origin.

Among the ten identified alien seeds and fruits picked up in the beach drift at San Jose, those of *Astrocaryum, Phytelephas, Prioria, Mangifera,* and

*Six kinds of alien drift fruits and seeds have defied all attempts to identify them. Photographs of three of the more distinctive sorts appear on the plates illustrating some of the San Jose drift fruits. One of these (PLATE 11, FIG. 4) is a dead, hollow, ovoid seed with an unusual and distinctive, oblique hilum. It much resembles the seed of *Mastichodendron Capiri* var. *tempisque* (Pittier) Cronq., as illustrated by Pittier, Contr. U. S. Nat. Herb. **13:** 461, plate 96E (1912). That species of the *Sapotaceae* ranges in Central America south to Panama. Its seeds, however, are slightly smaller than those found in the drift, show slight differences in hilum, and have a thin, polished brown testa rather than a slaty, opaque, gray one. Perhaps a half dozen seeds of the sort were seen at San Jose. Another unidentified drift fruit appears on PLATE 11, FIG. 5. It is a dusky biconvex fruit which separates into two thickish woody valves and formerly contained a single laterally compressed seed now disintegrated. It is uncommon in the San Jose drift and may be a legume, possibly that of *Copaifera* or *Dalbergia*. The third sort illustrated (PLATE 12, FIG. 4) is an empty, light-weight, 10-ribbed fruit (endocarp) formerly filled by a large, very plump, single seed, now disintegrated and represented only by the persisting papery shell of testa. It was observed in the drift only a few times. Its identity is a complete puzzle.

Sterculia could have had sources at many points in and about the Gulf of Panama. Indeed, it is not improbable that most of them may have originated on some of the Perlas Islands. Those of *Abuta*, *Sacoglottis*, *Calatola*, and *Lecythis*, however, judging from botanical evidence, most likely had a more remote source, probably further south on the so-called Choco Coast of Colombia. Hydrographic data, indeed, provide strong support for this belief. Waters in the Gulf of Panama, with San Jose near their center, are the northern reaches of a pronounced current from the south. Propelled by the prevailingly south and southwest winds on the Choco Coast the ocean waters move northward along the shores of western Colombia and eastern Panama into the Gulf of Panama, where, deflected by the coastline and pushed by north winds, they turn southward into the open sea. The path of this movement of waters in the Gulf of Panama varies somewhat with the seasons. During the rainy months it may tend to circle the Perlas Islands, but during the dry period, under the drive of the then very strong prevailing north winds, it begins its southern course near the middle of the Gulf in the general vicinity of San Jose. The Choco Current in its movement up the Colombian coast and through the Gulf of Panama is admirably fitted for rafting in alien drift to San Jose. Some of the alien fruits picked up on the island are indications that it can freight material long distances. The nature and volume of material delivered, however, can only be surmised.

Beach drift is a heterogeneous mixture of very diverse origins. With something added, something subtracted, and with endless re-sorting, it is changed by every tide touching it. Its components are not only buoyant materials of local origin but also the variety of flotsam brought in by currents from distant shores. Among the fruits and seeds of all classes present in the drift on San Jose there must be many unrecognizable alien ones. To be sure, practically all the drift fruits found on the island are identifiable as products of species growing there, but these species also occur at very many other places in the Panamanian area, and even beyond it. Wherever they grow they may make their contributions to drift and so to the flotsam that may be beached at San Jose. Accordingly, with the fruit or seeds of a particular species having a uniform that gives no clues as to their origin, a company of them encountered on the beach can be either a fraternal group from a community near by, or a family reunion with delegates gathered from afar. It is surprising but true that though a few of the fruits in the drift on San Jose can be recognized as alien, there are none present which bear intrinsic evidence of a local origin on the island. Actually our only means of estimating the proportion of alien and local fruits in the drift is from observations as to available sources and as to the factors operating locally in the assembling of this material.

Drift of obviously local origin is to be found on the beaches of San Jose most abundantly during the final third of the year. By the end of the wet season, about November, much material collected inland by rain-swollen streams has accumulated on the beaches and most of the local ocean-disseminated coastal plants are in process of freeing mature seeds. At the same time, after the months of gently variable winds characteristic of the wet season, the quantity of alien material in the drift is probably at a minimum. The greatest masses of foreign drift come to San Jose from the north and appear in greatest quantity and variety during the early part of the dry season when

there are strong and prevailing winds from the north. Fine displays of it are collected on the beaches along the south side of Bodega Bay and in the north facing E. M. Beach. Playa Grande, a superb length of strand facing southeast, has scanty drift. So also do other beaches with southerly exposure. The distribution of the coconut palm on the island tells a similar story. These palms on San Jose are natural plantings springing from ocean-borne fruits. Beaches on which they occur in any number are all provided with a northerly exposure. The chief sources of the alien drift that reaches the island are probably to be looked for in the other Perlas Islands lying off San Jose to the north and northeast. Of large size and with the best developed streams, Rey Island may well be the most important. All the other Perlas Islands have their own productions of local drift which, set free, could be driven by the north winds down upon San Jose Island. The important other sources of foreign drift are more remote and the means by which it reaches San Jose are indirect. As it moves through the Perlas Islands the Choco Current brings drift that north winds may also propel south to San Jose. This latter is the material picked up by the current on its course northward along hundreds of miles of Colombian and east-Panamanian coast. Judging from what is known concerning the ability of such currents to collect and transport drift, the amount delivered by the Choco Current within reach of San Jose may be considerable. Indeed, it may well make up a goodly fraction of the foreign drift blown down upon the island by the north winds.

Having discussed the nature and varied origins of the fruits and seeds present in the beached drift at San Jose, we can now proceed to the listing of the principal species represented. Conceivably, fruiting structures of every species growing about the area from which drift is gathered could be expected at one time or another on the beach of the island. Only those, however, which are ocean-borne and appear frequently and in some quantity on the strand are properly classed as beach fruits and so worthy of listing. The enumeration given below, accordingly, is chiefly concerned with those species whose fruits and seeds are recurring features in the drift at San Jose. Because of their special interest, however, the species responsible for the few recognized alien drift fruits have also been included. Details regarding all these species may be found in the descriptive catalogue concluding this report. Since little attention was given to the very small seeds and fruit in the San Jose drift, the present listing of them is incomplete.

**Astrocaryum* sp. PLATE 9, FIG. 4.
**Cocos nucifera*
**Manicaria saccifera* PLATE 9, FIG. 3.
Phytelephas sp. PLATE 9, FIG. 1.
**Ximenia americana*
Abuta sp. PLATE 10, FIG. 4.
**Chrysobalanus Icaco*
**Entada Gigas* PLATE 8, FIG. 1.
**Caesalpinia Bonduc* PLATE 8, FIG. 8.
Mora oleifera
**Prioria copaifera* PLATE 12, FIG. 2.
**Andira inermis*
**Canavalia rosea*
**Dioclea* spp. PLATE 8, FIG. 2–5.
**Dalbergia Brownei*
**Mucuna* spp. PLATE 8, FIG. 6–7.
**Pterocarpus officinalis* PLATE 11, FIG. 1.
Sacoglottis PLATE 10, FIG. 3.
**Citrus Aurantium*
Omphalea panamensis PLATE 12, FIG. 3.
**Hippomane Mancinella* PLATE 11, FIG. 2.
**Mangifera indica*
**Spondias Mombin* PLATE 11, FIG. 3.
Calatola sp. PLATE 10, FIG. 1–2.
**Elaeodendron xylocarpum*
**Hibiscus tiliaceus*
Sterculia apetala
**Guazuma ulmifolia*
Pelliciera rhizophorae PLATE 12, FIG. 1.
Rhizophora brevistyla
**Conocarpus erecta*
**Terminalia Catappa*

**Laguncularia racemosa*
Lecythis sp.
**Ipomoea pes-caprae*
**Avicennia nitida*
**Enallagma latifolia*
**Tecoma stans*
**Crescentia Cujete*

In the above list, as contributors to the drift on San Jose, are a surprising number of species widely known for their ocean-borne seeds and fruits. Those whose fruiting structures have been found in the Caribbean drift have been marked with an asterisk. They make up most of the San Jose list. They are plants of the tropical lowlands, and most of them, aided by ocean dissemination, are widely distributed along American coasts. A number of them grow also along the coasts of West Africa, and a few are to be found still further to the east along the shores of the Indian Ocean and into the East Indies. Some seem to have originated in America, but about half of them were probably differentiated in the Old World and subsequently extended their range to America by migrations from the east. Since many of them are confined to beaches and are dependent on ocean currents for dissemination, their presence on both of the now separated eastern and western coasts of tropical America suggests that they are an old assemblage, at least antedating the Pleiocene, when waters of the Caribbean and Pacific were last joined.

Curiously, there appears to have been almost no direct exchange of littoral and ocean-disseminated plants between the central Pacific and tropical West America. For some reason the great equatorial currents of the Pacific have been very ineffective as a transport between America and Polynesia. Copious sources of drift fruit and seeds are available in both the east and the west. The distances these currents traverse are no greater than those successfully navigated by seeds in currents in other parts of the world. Yet only in the distribution of *Rhizophora samoensis* does there seem to be any evidence that these currents may have been useful in plant dispersal in the eastern parts of the Pacific. The *Rhizophora*, the common bushy mangrove along the west coast of Central America, is known only from that area and from a few of the larger islands in eastern Polynesia. Its disrupted geographic distribution seems explicable only as the result of chance dissemination by currents from America westward to Polynesia. As a rare exception, however, it merely points up the general rule. Strand and ocean-disseminated plants of Polynesia usually have a relationship closer with plants of the East Indies than with any to be found in America. Some of the coastal plants of the Pacific islands are, to be sure, generally related to those of America, but this appears to have resulted almost entirely from old migrations of floras, not across the eastern Pacific, but rather through the tropics of the eastern hemisphere. For some reason the waters of the eastern Pacific have not been a highway, but rather a barrier, for ocean-disseminated species. A student of mere maps might expect Polynesian elements among the shore plants and drift fruits of San Jose, but actually none occur there.

In areas where a single major current is operative, drift very similar in botanical features can be found at widely separated localities. The degree of similarity is well illustrated in the comparison of the drift fruits of San Jose with those known to occur near Panama City and near Guayaquil. Data for

the two latter stations are derived from H. B. Guppy and are found in his two well-known books on the botany of drift, "Observations of a Naturalist in the Pacific," London, 1906, and "Plants, Seeds and Currents," London, 1917. Assembed they make up a short list of seeds and fruit collected by Guppy on the strand near Panama City and a second much longer one of fruits and seeds observed by him in and about the estuary of the Guayas River below Guayaquil, Ecuador. Though obviously incomplete and inadequate for detailed analysis, they involve the drift flora of the same coastal waters as that of San Jose and so provide some worth-while comparison. Near Panama City Guppy found seeds and fruits of *Astrocaryum, Entada, Prioria, Mucuna, Canavalia, Hippomane, Spondias,* and *Rhizophora.* All of them are represented in the drift on San Jose Island. The majority of those he observed in the drift below Guayaquil are also common beach objects at San Jose, viz., *Phytelephas, Entada, Canavalia, Dioclea, Mucuna, Spondias, Hibiscus, Laguncularia, Rhizophora, Ipomoea, Avicennia,* and *Crescentia.* Only three of the fruits seen near Guayaquil have not been actually found in the drift on the island, viz., *Anona glabra, Erythrina* (presumably *E. glauca*) and "*Gris cauliflora.*" The number probably should be reduced to two, since *Erythrina* grows at Orangetree Beach on San Jose and casts its seeds within reach of the tide, and so can confidently be expected to make at least some contribution to the drift of Bodega Bay. In any case, the drift fruits near Guayaquil, like those from near Panama City, are practically the same in kind as those found on San Jose. Two of the beach fruits which we know San Jose to share with the mainland station are of restricted occurrence. That of *Phytelephas,* shared by San Jose and Guayaquil, is known only in the drift at these places. The fruit of *Rhizophora,* from three stations, is the product of a species endemic to the Pacific coast and so known only from drift there. The great majority of the shared fruits, however, occur also in the West Indian drift and are known from many American coasts.

The drift of San Jose is very rich in the seeds and fruits found widely distributed on the beaches of tropical America, and is, in its main botanical features, characteristic of that found in the tropics of the Western Hemisphere. Present in it, however, are common fruits of seven kinds which are not present in the drift of other regions, viz., *Phytelephas, Abuta, Mora, Sacoglottis, Calatola, Pelliciera,* and *Rhizophora.* They are products of species which are so distributed geographically that their fruits reach the drift only in restricted areas. Such species are present in varying numbers in all parts of the world. Their fruits, mixed in with the common, widely distributed kinds, give a minor but distinctive character to drift along definite stretches of tropical coast and so allow it to be identified geographically. It seems probable that several systems of drift can eventually be so identified along the west coast of America. Nothing is recorded regarding the botanical composition of the drift along the coast of Central America. However, since other currents and the contributions of a rather different flora are involved, that drift is probably appreciably different from that south of Panama. San Jose probably shares in drift characteristic of the Bay of Panama and south to Ecuador, and some or all of the seven fruits mentioned may prove distinctive of it.

IDENTIFICATION

A large proportion of the plants native to San Jose are readily recognizable and easily associated with their proper names. Many of the common ones are identifiable from details mentioned in the preceding general account of the vegetation. Others can be identified in a direct manner. A large number of the island species, nearly 80 per cent, occur also in the Canal Zone. These are described and differentiated in P. C. Standley's "Flora of the Panama Canal Zone," published by the Smithsonian Institution as—Contribution from the U. S. National Herbarium, volume 27, pp. 1–416, plates 1–66 (1928). The book is a technical synopsis of about two thousand species and of necessity distinguishes families, genera, and species by details in the organization and structure of their flowers and fruits. For those familiar with botanical terminology it is very useful in naming the island plants. It offers the only practical means of identifying the grasses, sedges, and other smaller herbaceous plants of San Jose. The book, furthermore, contains illustrations of some common island plants and much general and specific information pertaining to island species. It should be used along with the present report by those interested in the San Jose flora.

In the following paragraphs an attempt has been made to supply a means whereby many of the island plants can be identified without the use of flowers or fruit. Keys have been given for the shrubs, trees, and vines, and also for the orchids native on San Jose. They are based chiefly on characters presented in the leaves and stems of these plants. Only the occasional use of a hand lens is required. They sort out the various kinds of plants into smaller and smaller mutually exclusive groups according to whether they have or have not certain peculiarities. By the use of these keys it can be determined that a given plant is one of a very restricted group. Exactly which one can be established by elimination after reading the detailed account of the species found in the catalogue that concludes this report. The information here furnished makes it possible to identify quickly and positively most of the trees, shrubs, vines, and orchids known from the island and should be especially useful in naming plants that bear neither flowers nor fruit.

For the non-botanist a few words of explanation may make the keys more readily intelligible. In general the terms used are those defined in the average desk dictionary. Such a dictionary, under "leaf," usually provides an illustration showing the common leaf shapes. A few matters concerning leaf structure and leaf attachment deserve some special comment. In most plants the leaf is *simple,* consisting of a blade, usually borne on a leaf stalk called the *petiole.* In *compound leaves* the simple blade is replaced by *leaflets* of varying number and arrangemnet. All leaves, simple or compound, are associated with a bud (which can develop into a shoot or flower) that is borne just above the point where the leaf stalk is attached to the stem. This fact is important in deciding whether a leaf is simple or compound. The leaflet, being only a fraction of a leaf, has no such bud in the angle (or *axil*) at its base. The bud is present only where the whole leaf joins the stem. In *pinnate* or *pinnately compound* leaves, those of the walnut, hickory, and ash being good examples, the leaflets are borne on either side of the continuation of the leaf stalk known as the *rhachis.* Some pinnate leaves have a terminal leaflet and are *odd-pinnate,* others lack it and are

even-pinnate. When the leaflets are pinnately arranged, not along the rhachis but upon pinnately arranged branches of the rhachis, the leaf is then *bicompound* or *bipinnate*. *Palmate* or *palmately compound* leaves are those in which the leaflets are all attached at the outer end of the leaf stalk and diverge from it. The leaf of the common horse chestnut provides a familiar example. *Palmately lobed* leaves, exemplified by the maple leaf, are simple leaves having several strong ribs that diverge from the top of the leaf stalk and act as the midrib for each of the several lobes of the blade. Leaves, simple or compound, are borne on alternate sides of the twig (*alternate*) or are found on the branch in opposing pairs (*opposite*). They always have a leaf bud at their base, and upon falling away always expose the bud and leave leaf scars on the twig.

KEY TO THE TREES AND SHRUBS

Leaves compound, with 2 or more distinct leaflets.
  Leaflets digitate.
    Bombax.
    Didymopanax, leaflets silky beneath.
    Tabebuia, leaves opposite.
  Leaflets pinnately arranged.
    Leaves bipinnate.
      Acacia.
      Prosopis.
      Caesalpinia.
      Jacaranda, leaves opposite.
    Leaves simply pinnate.
      Leaves even-pinnate; leaflets in even numbers.
        Pairs of leaflets 2.
          Cassia.
          Mora.
          Matayba.
        Pairs of leaflets 3 to many.
          Inga, leaf rhachis winged.
          Pithecollobium.
          Simaba, small tree with palmlike habit.
          Cedrella, bark furrowed.
          Guarea.
      Leaves odd-pinnate; leaflets in odd numbers.
        Leaflets usually 3.
          Swartzia.
          Erythrina, twigs with thorns.
          Clitoria.
          Connarus.
          Allophyllus, leaflets toothed.
        Leaflets 5 or more.
          Andira.
          Lonchocarpus, ant-plant.
          Pterocarpus, swamp tree.
          Machaerium.
          Indigofera, leaflets 3 cm. long or less.
          Tetragastris.
          Protium, leaflets with abrupt prolonged tip.
          Bursera, bark coppery.
          Zanthoxylum, twigs thorny.
          Cedrella.
          Trichilia.

Spondias.
Cupania, plant conspicuously brown-hairy.
Matayba.
Tecoma, leaves opposite.

Leaves simple.
Leaf palmately lobed.
Cecropia, blade attached on back.
Cnidoscolus, nettle-hairs.
Ochroma, hairs stellate.
Cochlospermum, leaf margin serrate.

Leaf not lobed.
Leaves opposite on twig.
Blade with 3 or more longitudinal ribs connected by a ladder-like arrangement of cross veins.
Miconia.
Henriettea.
Clidemia.
Heterotrichum.
Leandra.
Conostegia.

Blade not as above.
Plant with latex.
Clusia, leaves very thick.
Stemmadenia.

Plant without latex.
Trees with roots frequently inundated by saline water.
Rhizophora, stilt tree.
Laguncularia.
Avicennia, herbage light green.

Trees growing away from salt water.
Leaves of pair very unequal in size and petiole length.
Trichanthera.
Leaves of pair equal or practically so.
Leaves triple-ribbed; scabrous on upper surface.
Eupatorium.
Calea.
Clibadium.
Leaves with single midrib.
Leaf margin distinctly toothed.
Cassipourea, apparently glabrous.
Callicarpa.
Cornutia.
Leaf margin not toothed.
Leaves more than 2 at most stem nodes.
Psychotria triphylla, leaves in threes.
Hamelia, leaves in fours.
Leaves borne 2 at each node.
Under surface of leaves dotted with minute oil cells (lens!)
Leaves and new shoots entirely glabrous.
Marila, leaves 6–10 cm. broad.
Calycolpus.
Psidium Sartorianum.
Eugenia antiquae.
Myrciaria.
Leaves and new shoots with hairs (lens!).
Psidium guineense.
Myrcia.
Eugenia origanoides.
Myrciaria.

Under surface of leaves not dotted with oil cells.
Leaves and new shoots glabrous.
Cassipourea.
Citharexylum.
Aegiphila.
Macrocnemum.
Palicourea guianensis.
Psychotria.
Alibertia.
Hamelia.
Leaves and new shoots with some spreading or appressed hairs (lens!).
Petiole of larger leaves usually 1.5 cm. long or more.
Vismia, leaves conspicuously brown beneath.
Callicarpa, hairs stellate.
Cornutia.
Hamelia.
Isertia, leaves large, up to 18 cm. broad.
Gonzalaguna, leaves lanceolate, 4 cm. or less broad.
Amaioua.
Macrocnemum.
Petiole of larger leaves less than 1.5 cm. long.
Pubescence on lower leaf face of ascending or erect hairs.
Byrsonima.
Psychotria undata.
Genipa, leaves large, to 25 cm. broad.
Gonzalaguna, leaves lanceolate.
Pubescence on lower leaf face decidedly appressed.
Hiraea, hairs attached not at end but at middle.
Bunchosia, same as last.
Cassipourea.
Macrocnemum.
Guettarda, leaves less than 7 cm. long.
Amaioua.
Leaves alternate on twig.
Trees or shrubs with milky latex.
Ficus, terminal bud elongate, latex copious.
Hippomane, confined to beaches.
Pouteria.
Manilkara, tree with checkered bark.
Plumeria, leaves clustered on thick stems, latex copious.
Trees or shrubs without milky latex.
Leaf margin variously toothed, at least toward apex.
Leaf armed with thorns on petiole and midrib.
Solanum lanceifolium.
Solanum isthmicum.
Leaf unarmed.
Leaves evidently hairy, or with a coating of minute hairs beneath.
Lowest pair of veins small.
Zuelania.
Lowest pair of veins the largest and most conspicuous.
Upper leaf face scabrous; hairs simple.
Trema.
Upper leaf face velvety or glabrous and smooth; hairs stellate.
Luehea.
Apeiba.
Guazuma.
Leaves glabrous or only obscurely pubescent.
Leaf triple-ribbed from base.
Hasseltia.

Leaf with one medial rib.
Leaves very large, becoming 10 dm. long.
Gustavia.
Leaves less than 1.5 dm. long.
Blade with minute translucent lines and dots (lens!).
Casearia.
Blade without translucent lines and dots.
Roupala, petiole well developed.
Elaeodendron.
Hippomane, petiole well developed.
Banara, coarse stalked gland on petiole.
Xylosma, branched thorns on branches.
Casearia myriantha, herbage of somber hue.
Ouratea, margin with sawlike teeth.
Leaf margin not toothed.
Blade distinctly broadest above middle.
Terminal bud of twig very slender and elongate, 1–5 cm. long.
Pelliciera, trunk conic at base.
Rapanea.
Terminal bud short.
Chrysobalanus, coastal shrub with broad rounded leaves.
Anacardium, giant tree.
Ilex.
Ternstroemia.
Souroubea, epiphytic tree.
Terminalia, shore tree.
Pouteria.
Manilkara, giant tree.
Enallagma.
Blade distinctly broadest at or below middle.
Leaf scabrous on upper surface.
Piper breve.
Curatella.
Cordia.
Tournefortia.
Baccharis.
Leaf smooth, not harsh to touch, on upper surface.
Blade heart-shaped, palmately several-ribbed.
Piper marginatum, petiole winged.
Hibiscus.
Ochroma.
Blade not cordate, with midrib.
Twigs conspicuously swollen at nodes.
Piper.
Twigs not conspicuously swollen at nodes.
Leaf blade evidently hairy, or beneath covered with a coating of minute hairs, or twigs bearing evident spreading hairs.
Leaves white or very pallid beneath.
Coussapoa, epiphytic and strangling tree.
Lycoseris, clambering shrub.
Leaves gray to tawny beneath.
Blades over 1.5 dm. long, with conspicuous and noticeably parallel veins.
Anona.
Zuelania.
Blades less than 1.5 dm. long.
Xylopia.
Hirtella.
Solanum extensum, hairs oily.
Solanum perattenuatum, hairs oily.

Leaf blades glabrous or apparently so.
Under lens twigs, petiole, and leaf blade glabrous even when young.
Ximenia, twigs with spines 1–2 cm. long.
Coccoloba, petiole attached to collar surrounding twig.
Anona glabra.
Capparis.
Licania, leaves with 15 or more pairs of veins.
Hippomane, petiole as long or half as long as blade.
Phyllanthus.
Mabea.
Casearia sylvestris, translucent dots in leaf.
Conocarpus, pores along midrib at base of veins below.
Under lens twigs, petioles and blades bearing some hairs or scales, at least when young.
Bearing minute scales.
Pera.
Ardisia.
Bearing minute hairs.
Roupala, petiole usually well developed.
Xylopia.
Anona purpurea, leaf large, 10–15 cm. broad.
Ocotea.
Phoebe.
Nectandra.
Dalbergia, twigs wrapping themselves about support.
Colubrina, a pair of wartlike glands at base of blade.
Casearia myriantha, herbage of somber hue.
Conocarpus, pores along midrib at base of veins.
Pouteria campechiana.
Cestrum.

KEY TO CLIMBING PLANTS

Leaves opposite on stem.
Leaves compound, composed of distinct leaflets.
Leaflets 5–9 or one or more replaced by tendrils.
Anemopaegma, 4–5 leaflets, tendrils simple.
Pleonotoma, 6–9 leaflets, tendrils branched, stem sharply 4-angled.
Leaflets 3 or middle one replaced by a tendril.
Adenocalymma, swamp vine.
Arrabidaea, leaflets becoming red or pink in drying.
Callichlamys.
Cydista.
Amphilophium, twigs strongly 5-ribbed, pubescent.
Martinella, tendrils usually branched.
Macfadyena, tendrils clawlike.
Phryganocydia.
Pseudocalymma, herbage with garlic odor.
Leaves simple.
Plant with milky latex.
Marsdenia.
Funastrum, leaves heart-shaped.
Blepharodon.
Macroscepis, leaves and twigs bristly.
Fischeria, leaves and twigs bristly.
Forsteronia.
Rhabdadenia, about mangrove swamps.
Prestonia.
Peltastes, petiole attached to back of blade.
Mandevilla.

Plant without white milky latex.
Producing hooked tendrils from the leaf axils; leaves triple-ribbed.
Strychnos.
Producing no tendrils.
Twigs forming hitches, wrapping about a support and then elongating and thickening in a normal manner.
Hippocratea.
Hylenaea.
Elachyptera.
Twigs not forming hitches about supporting branches.
Leaves golden-dotted beneath (lens!).
Combretum.
Leaves not golden-dotted.
Leaves conspicuously toothed.
Drymonia.
Leaves entire or nearly so.
Heteropterys.
Tetrapteris.
Stigmaphyllon.
Rhabdadenia, about mangrove swamps.
Peltastes, petiole attached to back of blades.
Prestonia.
Mandevilla.
Chiococca, stipules subulate.
Sabacea, stipules broad, herbaceous.
Mikania.
Leaves alternate along stem.
Plant a fern.
Plant scrambling forming large colonies; spores borne in dots on back of leaf segments.
Dicranopteris pectinata.
Plant twining, occurring singly; spores borne on projections along the margin of the leaf segments.
Segments of leaf pinnately arranged, minutely hairy.
Lygodium venustum.
Segments of frond palmately arranged, glabrous.
Lygodium radiatum.
Plant bearing flowers.
Leaf in outline suggestive of the footprint of a cow, composed of two leaflets united in varying degrees along their inner margins from the base upward; stems becoming ribbon-like.
Bauhinia.
Leaf not as above.
Leaf compound, composed of 3 to many distinct leaflets.
Plant with tendrils.
Entada Gigas, tendril on leaf.
Serjania, tendril from leaf axil.
Cissus, tendril on stem opposite leaf.
Plant lacking tendrils.
Leaf twice compound.
Caesalpinia, leaf thorny.
Entada.
Serjania, leaflets frequently toothed.
Leaf simply pinnate.
Leaflets 5 or more.
Cnestidium.
Rourea.
Machaerium.

Leaflets 3.
Vine coarse and woody.
Connarus.
Dioclea.
Clitoria portobellensis.
Cissus.
Vine slender, more or less herbaceous.
Calapogonium, pubescence usually shaggy.
Canavalia, trailing on beach.
Centrosema.
Clitoria rubiginosa.
Galactia.
Mucuna.
Phaseolus.
Rhynchosia.
Vigna, along beach.
Cissus.
Leaf simple.
Plant with tendrils.
Tendrils huge, over 5 dm. long and over 3 mm. thick.
Omphalea.
Tendrils moderate in size.
Tendril from the axil of a leaf or bract.
Gouania, leaf ovate to elliptic.
Passiflora, leaf moon-shaped or lobed.
Tendril not arising from the axil of leaf or bract.
Tendril borne on side of stem almost 90° from leaf.
Melothria, stems very slender.
Cayaponia, giant vine with coarse stems.
Tendrils borne on opposite side of stems, 180° from leaf.
Cissus.
Vitis.
Plant without tendrils.
Leaves grasslike; a climbing sedge with razor-sharp stems and leaves.
Scleria secans.
Leaves not at all grasslike.
Leaves thorny.
Solanum lanceifolium.
Leaves unarmed.
Leaves conspicuously lobed.
Dalechampia, with irritating hairs.
Calonyction.
Ipomoea.
Leaves not lobed.
Blades cordate to sagittate with a deep conspicuous sinus at base.
Philodendron.
Dioscorea.
Aristolochia.
Odontocarya.
Cissus sicyoides.
Stictocardia.
Merremia.
Jacquemontia.
Blade not as above, sinus lacking or if present only obscurely developed.
Leaves scabrous on upper surface.
Davilla, leaf veins prominent, parallel.
Tetracera, leaf veins prominent, parallel.
Cordia, petiole base becoming a spur.
Tournefortia.

Leaves not rough to touch on upper surface.
Blades broadest above the middle.
Dolicarpus, usually toothed leaves.
Souroubea.
Clusia, leaves very thick.
Blades broadest at or below middle.
Petioles with winged margins.
Philodendron guatemalense.
Monstera, leaves usually perforated.
Petioles slender, not winged.
Smilax, twigs and stem thorny.
Securidaca, stems hitched about support.
Dalbergia, stems hitched about support.
Omphalea.
Gouania, leaves with rounded teeth.
Ipomoea pes-caprae, trailing beach plant.
Tournefortia.
Solanum extensum, with oily hairs.
Solanum perattenuatum, with oily hairs.

KEY TO ORCHIDS

Plants terrestrial, rooted in soil in sunny open places.
Flowering plant leafy, creamy white flowers with a very elongate spur. *Habenaria.*
Flowering plant leafless; flowers without an elongate spur.
Flowers creamy orange, Bald Hill in wet season. *Spiranthes.*
Flowers pink or purple, sea cliffs in dry season. *Bletia.*
Plants growing on trees or on bare rocks.
Plant with pseudobulbs, i. e., plump fleshy usually bulb-like branches terminated by one or two leaves and differing from ordinary swollen stems in bearing no leaves nor leaf scars on their sides.
Pseudobulbs borne along an elongating leafy stem that can become a meter or more long; leaves 1–1.5 cm. broad, linear. *Maxillaria Camaridii.*
Pseudobulbs borne at the base of the plant or at most 5 cm. above it.
Pseudobulbs 10–15 cm. long, compressed, highly polished, with 4 or more conspicuous narrow high ridges down each side; leaves 5–10 dm. long. *Oncidium panamense.*
Pseudobulbs usually less than 10 cm. long, never with conspicuous elevated ridging; leaves less than 4 dm. long.
Pseudobulbs only moderately compressed laterally, crowded in dense masses, in resting state crowned with hard sharp bits of persisting leaf base.
Pseudobulbs 5–7 cm. long, broadest below middle and gradually narrowed towards apex; leaves with well-developed petiole 5–20 cm. long, under surface traversed by 3 very prominent ribs; flowers white borne on leafy plant. *Xylobium.*
Pseudobulbs 3–4 cm. long, broadest at middle, elliptic in lateral outline; leaves without distinct petiole, under surface traversed by 5 or 6 prominent ribs; flowers yellow, appearing when the plant is leafless. *Lycaste.*
Pseudobulbs conspicuously flattened, 4–6 times as broad as thick.
Pseudobulbs 3–5 cm. long, crowded and commonly overlapping and usually strongly flattened against the tree, somewhat lustrous; leaves borne only on the pseudobulbs and there only singly. *Trichopilia.*
Pseudobulbs 8–15 cm. long, few and well spaced, not appressed against tree, surface opaque, bearing 2 leaves each; stems usually producing several leaves below the pseudobulbs. *Aspasia.*

Plants without true pseudobulbs.
Stems conspicuously swollen, thickest towards the middle, 1.5–5 cm. in diameter.
Inflorescence developing from among the leaves at the apex of the usually hollow and ant-inhabited swollen stems. *Diacrium*.
Inflorescence developing from the base of the swollen leaf-bearing stem.
Leaves very large and coarse, usually 4 dm. or more long, rather thin with numerous prominent ribs; swollen stems in leafless resting condition armed with pungently tipped leaf bases.
Flowers unspotted, with large pouch-like lip. *Catasetum*.
Flowers spotted, the small lip marked with red. *Cyrtopodium*.
Leaves 1–1.5 dm. long, thick and stiff, not conspicuously ribbed, persistent leaf bases not pungently tipped; flowers small, without pouch. *Epidendrum Stamfordianum*.
Stems not noticeably swollen or if so less than 1 cm. thick.
Leaf-bearing stems short or much reduced, evidently shorter than the leaves.
Flower tiny, less than 5 mm. broad, orange. *Pleurothallis*.
Flowers larger, over 1 cm. broad.
Flower white, large; mostly on seacoast. *Brassavola*.
Flower yellow.
Flowers numerous, projected out on a long-stalked inflorescence. *Oncidium ebrachiatum*.
Flowers few, barely emerging from among the leaf sheaths. *Maxillaria crassifolia*.
Leaf-bearing stems evidently elongate, much longer than their leaves.
Leaves definitely over 1 cm. broad.
Leaves fleshy, with only the midrib prominent beneath; flowers clustered; plant confined to earthen ant nests. *Epidendrum imatophyllum*.
Leaves rather thin, firm, traversed by 5 or more prominent ribs; flowers borne singly, large. *Sobralia*.
Leaves smaller, distinctly less than 1 cm. broad, flowers small.
Stems with one or only a very few pairs of grasslike leaves. *Scaphyglottis*.
Stems with the numerous alternating leaves not grasslike in appearance.
Leaves spreading and distinctly separated. *Dichaea*.
Leaves crowded and overlapping, the whole leafy branch suggesting a braided belt in appearance. *Lockhartia*.

CATALOGUE OF FLOWERING PLANTS

Listed and discussed in the following catalogue are the 631 species of flowering plants known to grow without cultivation on San Jose Island. There are a few species which do not grow on the island but do have their fruits regularly washed up on its beaches, and these have also been included in the catalogue. The 513 species which appear to be indigenous to San Jose are listed in **black face type.** Species of other categories, the 114 immigrant weeds, the nine drift fruits mentioned above, and the four cultivated plants persisting from early settlements, are all listed in other type, CAPITALS AND SMALL CAPITALS. None of the numerous ornamental and fruit plants deliberately brought to the island since 1943 have been included.

In my account of each species I have given my own observations regarding its behavior and distribution on the island, and usually also some descriptive details useful in identifying the plant. My chief concern has been with the plants as they occur on San Jose Island. The measurements and the descriptions of behavior and structure given are based only upon island plants unless otherwise stated. My last observations were made in mid-February, 1946. The date is of some importance in judging the data presented

concerning immigrant plants and the plants of the rapidly changing second-growth associations.

Available for detailed analysis and comparison were 1413 collections of herbarium specimens which I made on San Jose, as well as almost six hundred made by E. O. Erlanson, 101 by James R. Harlow, twenty-four by N. J. Andersson, and twelve by W. W. Campbell. This material was critically studied and identified at two botanical establishments of Harvard University, the Arnold Arboretum and the Gray Herbarium. The identifications of the individual collections are recorded at the conclusion of the discussion of each species in the catalogue by citation according to collector and collection number. The collections of Andersson were received on loan from the Natural History Museum, Stockholm, and forty-eight unicate collections of Erlanson on loan from the United States National Herbarium, Washington. All other collections cited, however, are preserved at the Arnold Arboretum. The types of new species, unless otherwise indicated, are preserved there also.

The identifications of the island flora have been worked out with some care both in library and herbarium. In many cases much continental material has been studied, much literature gone over, and various type specimens examined. The names of many species have been traced back in the literature to original sources. Various taxonomic notes, as a consequence, have been accumulated. These have been appended to my discussion of the island plants.

For the convenience of those using this catalogue in conjunction with Standley's "Flora of the Panama Canal Zone," I have given references to that very useful book. These consist of the abbreviation "Fl. C. Z." and a page reference and are to be found at the conclusion of the account of all those species which occur both in the Canal Zone and on San Jose Island. In cases where the botanical name here accepted differs from that used by Standley, the name used by the latter has been appended to the page reference.

In measurements of plants and their parts I have followed general scientific usage and used the metric system. The English system, however, has been used for geographical measurements. Though inconsistent, this is practical, since the island is a military area, where all detailed maps are in English system and the yard is a standard surveyors' unit.

Common names have been given for only a few of the island plants. Not more than a dozen are in common use by the English-speaking personnel on the island. Many more, however, are used by the Spanish-speaking laborers working for the Engineers, and many of these I have recorded. Most of the plants of San Jose have no well-established and widely used common names. To be sure, various names for many of the island species can be found recorded in botanical books, but the vast majority of such names are very local in use and meaningless away from a particular dwelling, village, or district. When plants of the island have names widely used in Panama or over most of Central America or the West Indies, these names have been given also. For most of the trees, shrubs, and vines, including some of the most common and important on the island, only the Latin botanical names are available. They should be used. Such names are no stranger than unfamiliar Spanish or Indian designations. They are vastly more precise, and many of them can be found defined in any large dictionary.

GRAMINEAE

(Identifications by Mrs. Agnes Chase)

Andropogon angustatus (Presl) Steud.

Growing on thin soil in open places at the summit of the sea cliffs at East Harbor and with other herbs on flat-topped rocks along the coast of Hicaco Island. The species grows in Cuba and from Mexico to Brazil. (Fl. C. Z. p. 85). *Johnston 819, 923.*

Andropogon bicornis L.

This coarse grass was observed in November 1944, in the then undisturbed western portion of the Bald Hill grassland and also in disturbed soil in the clearing about the Navy Station. The species is widely distributed in tropical America. (Fl. C. Z. p. 85). *Johnston 329; Erlanson 349.*

Andropogon brevifolius Sw.

Growing in the Bald Hill grassland and in open places with thin soil along the coast at East Harbor, on Hicaco Island and near Orangetree Beach. The species ranges widely in the tropics. (Fl. C. Z. p. 84). *Johnston 833, 881, 924, 934, 947.*

Andropogon leucostachyus HBK.

Collected by Erlanson in the Bald Hill grassland. The species ranges widely in tropical America. (Fl. C. Z. p. 85). *Erlanson 313.*

Aristida capillacea Lam.

Disturbed open places in the Bald Hill grassland. Widely distributed in tropical America. (Fl. C. Z. p. 74). *Johnston 886.*

Aristida jorullensis Kunth

Open places with thin soil at the summit of the sea cliffs at East Harbor. The species ranges from Mexico to Panama. (Fl. C. Z. p. 74). *Johnston 842.*

Aristida ternipes Cav.

Growing in shelter of bushes on area of thin soil above the sea cliffs at East Harbor. Ranging from Texas to Colombia. (Fl. C. Z. p. 74). *Johnston 1256.*

Avena sativa L.

In January 1946 growing on refuse near the Goat Barns.

Axonopus aureus Beauv.

One of the dominant species in the Bald Hill grassland and apparently native nowhere else on the island. Clumps of the plant, for use in erosion control, were transplanted in late 1945 to banks of fill at the Cross Roads and near Headquarters at Main Camp. The species is widely distributed in tropical America. (Fl. C. Z. p. 76). *Johnston 30, 882; Harlow 71.*

Axonopus capillaris (Lam.) Chase

Growing on the flat tops of large rocks along the coast at Main Beach and on a steep slope of thin soil near Orangetree Beach. Ranging from Costa Rica and Trinidad to Brazil. *Johnston 124, 950.*

Axonopus centralis Chase

Growing in a moist sheltered place along the margin of the forest fringing the Bald Hill grassland. Known from Salvador, Nicaragua, Panama and Venezuela. (Fl. C. Z. p. 76). *Johnston 23.*

Axonopus compressus (Sw.) Beauv. Carpet Grass

In January 1946 established at the roadside back of Main Beach and about the Goat Barn. At the Goat Barn it grew with species of southern United States evidently introduced on the island in unclean hay shipped from New Orleans. Almost certainly it had the same origin. The plants found at the roadside back of Main Beach, however, probably represent a second introduction, one direct from the Isthmus. The species is widely distributed in the warmer parts of America. (Fl. C. Z. p. 76). *Johnston 861, 1233, 1235.*

Cenchrus Brownii R. & S. Bur Grass

This plant was not seen in October and November 1944. In March 1945 a few well-established colonies of fruiting plants grew along the road between the Guard House and the Main Beach. Erlanson collected fruiting plants at the Navy Station in May 1945. In January 1946 it was a common pestiferous weed at the Navy Station, in many places about the Camp area, and along the road between Main Camp and the Cross Roads. It had also appeared at the Air Strip, and a few plants were even growing along the trail leading into Area 11A at the northern end of the island. In one more year it would likely be a nuisance along roads and in clearings in all parts of the island. The species is clearly an emigrant from the Isthmus. Ranging from Florida to Brazil. (Fl. C. Z. p. 84, sub *C. viridis*). *Johnston 750; Erlanson 130, 331.*

Chloris radiata (L.) Sw.

Abundant in disturbed bottom-land at the head of Camp Valley forest. The species is widely distributed in tropical America. (Fl. C. Z. p. 74). *Johnston 392.*

Cynodon Dactylon (L.) Pers. Bermuda Grass

Growing as a lawn-grass at the Navy Station and at Main Camp in mid-1944, where it still persisted in February 1946. At the latter date it was well established as a weed about the Goat Barn and on the fill along Red Hill Grade. An Old World species now widely distributed in the warmer parts of America. (Fl. C. Z. p. 74).

Dactyloctenium aegyptium (L.) Richt.

Well established in the clearings back of Main Beach in October 1944 and still abundant there in January 1946, but not found elsewhere in the Camp area. Erlanson collected it in June 1945 on clearings near the Engineer Camp. A species of the Old World now widely distributed in the American tropics. (Fl. C. Z. p. 74). *Johnston 1375; Erlanson 242.*

Digitaria horizontalis Willd.

In January 1946 locally abundant in the clearing about the water pump for the Engineer Camp. Evidently a recent emigrant from the Isthmus. Widely distributed in the American tropics. (Fl. C. Z. p. 76). *Johnston 1397.*

DIGITARIA SANGUINALIS (L.) Scop. CRAB GRASS

First collected on the island in April 1945, when it was found on the fill along Red Hill Grade. Erlanson collected it at Main Beach in June 1945. In January 1946 it was a generally distributed weed in the vicinity of Main Camp, the Goat Barn, the Cross Roads, the Engineer Camp, on Red Hill Grade and about the Air Strip and adjacent parts of East Road. Scattered plants were seen along the West Loop, Canyon Road and Bald Hill Road. A very widely distributed weed in temperate and tropical regions. (Fl. C. Z. p. 76). *Johnston 683, 859, 991, 1398; Erlanson 335.*

ECHINOCHLOA COLONUM (L.) Link

The first records of this species on the island are collections made by Erlanson in May 1945 along the road near Main Beach and near Red Hill Grade. He collected it near the Goat Barn in July. By January 1946 it had become a widely distributed weed along roads and was common about Main Camp, the Goat Barn, the Engineer Camp, the Cross Roads and the Air Strip. Scattered plants were seen on the Loop, Canyon Road and Bald Hill Road. A species of the Old World widely distributed in America as a weed. (Fl. C. Z. p. 83). *Johnston 856; Erlanson 141, 169, 470; Harlow 50.*

ECHINOCHLOA CRUS-PAVONIS (HBK.) Schult.

Collected at the Goat Barn in May 1945 and still persisting there at the end of the year. In January 1946 colonies of it were found in disturbed ground along the Air Strip. The species is an emigrant from the Isthmus. Ranging from Mexico to Argentina. (Fl. C. Z. p. 83). *Johnston 1024, 1234; Erlanson 465, 466.*

ELEUSINE INDICA (L.) Gaertn.

In June 1945 Erlanson collected this plant at Main Beach. In January 1946 I found it as a weed in the lawns at Main Camp. It was also common at the Goat Barn. A native of the Old World now widely distributed in America. (Fl. C. Z. p. 74). *Johnston 995; Erlanson 337; Harlow 48.*

ERAGROSTIS BARRELIERI Daveau

A small weed frequent in the abandoned corral at the Goat Barn in January 1946. The species is not reported from Central America. It was probably introduced onto the island in unclean hay from the United States. A European weed introduced into southern United States and the West Indies. *Johnston 1150.*

ERAGROSTIS CILIANENSIS (All.) Link

A few plants were found in the abandoned corral at the Goat Barn in January 1946. The species is not reported from Panama and was probably introduced on the island in unclean hay from the United States. A European weed common in temperate regions; rare in the tropics. *Johnston 1152.*

Eragrostis ciliaris (L.) R. Br.

Bare gravelly places on steep seaward slopes on Hicaco Island and on the islet off the point of land south of Playa Grande. Evidently a native plant! The species is very widely distributed. (Fl. C. Z. p. 72). *Johnston 935, 1303.*

ERAGROSTIS CURTIPEDICELLATA Buckley

Locally well established about the rabbit hutches at the Goat Barn in January 1946. The species is known only from Texas, Oklahoma, Arkansas and New Mexico and was very probably introduced on San Jose in unclean hay from one of the states mentioned.. *Johnston 1228.*

ERAGROSTIS SPECTABILIS (Pursh) Steud.

A goodly number of vigorous fruiting plants were found in the abandoned corral at the Goat Barn in January 1946. The species ranges widely over the eastern half of the United States and into northern Mexico. It was probably introduced on San Jose in unclean hay from the United States. *Johnston 1229.*

Guadua aculeata Rupr. WILD BAMBOO

Seen at only three localities on the island. There are two large colonies of the plant. One is located at the head of a steep, open ravine on a hillside less than a quarter-mile inland from Mango Beach. Another occupies the narrow crest of the ridge forming the point of land at the south side of the first cove south of South Beach. A young colony, which has developed since the road was cut, occurs at the roadside along the West Loop, about a quarter-mile north of Little Butch Trail and near the giant spiny *Bombax* which is a landmark along that section of the road.

The mature plants have many erect or gracefully curving canes, 6–12 m. tall, which are mostly 20–30 mm. thick and never more than 40 mm. in diameter. The canes are grayish or somewhat bluish green in color and are covered with minute stiff hairs that irritate the skin when the plant is handled. At ground level they grow 1–2 dm. apart, from few to several dozens in clumps 3–30 dm. broad. Numerous such clumps make up the colonies of the plant. The vigorously growing new canes, as they grow towards full height, are leafless and unbranched and suggestive of fish-poles. The tightly appressed sheaths in which they are clothed eventually open and fall off, usually when the buds encased by them begin their growth. The canes function for at least several seasons and perhaps even longer.

Leaves are produced only on the branches of the cane and are renewed annually. They are dropped early in the dry season and are replaced towards the beginning of the wet season by the leaves of newly developed secondary branches. Many of the primary branches on the canes eventually become thickened, hard, recurving spurs, 1–7 cm. long. These woody, blunt-pointed spurs are suggestive of grappling devices. In some genera similar spurs, by hooking over parts of adjacent plants, give support to the slender elongate stems bearing them. In this bamboo, however, no such function was obvious. In April 1945 two types of foliar buds were found on the nearly leafless plants near South Harbor. There were great numbers of the very slender buds which would elongate into the leaf-bearing twigs of the coming wet season, and there were large numbers of a special kind of bud produced only on the spurs along the old canes. These latter were large, plump, and firm, 4–5 cm. long and 8–15 mm. thick. They broke off easily and possibly served for vegetative reproduction. The colonies of bamboo were visited and studied during every month from November to May, inclusive. No flowers were found nor was there evidence of past flowering or flowering to

come. Each colony contained numerous dead canes. Canes did not flower before dying.

The young colony of the plant on the Loop deserves comment. It grew along the road in soil not free from the activities of bulldozers and graders and so available to new plants not much, if at all, before June 1944. In January 1946, when at most one and a half years old, it consisted of two clumps, these about 5 dm. apart and each 4.5 dm. broad and containing numerous canes. The canes were 4–5 m. tall. Many were 12 mm. thick and the largest ones were 25 mm. in diameter at the base. The plant made a sizable display at the roadside. One is forced to wonder how it came to grow there. It seems unlikely that seeds of the plant would be widely scattered in the soil. The species, like other members of its group, apparently flowers and fruits very rarely. Furthermore, the nearest known mature colony is nearly three miles away, remote from roads and visited by very few people. The species is known fom Guatemala, Honduras, Panama, and South America. (Fl. C. Z. p. 72, sub *G. angustifolia*). *Johnston 242, 800.*

Gynerium sagittatum (Aubl.) Beauv. WILD CANE

A conspicuous plant in the thickets near the coast, particularly on steep seaward slopes. It usually grows in company with *Hibiscus tiliaceus* and is especially common in the vicinity of Main Camp where it is a feature in the landscape. The plant grows 2–5 m. tall. Its erect, unbranched stems, 2–3 cm. thick, are clothed by the overlapping, persisting, somewhat woolly leaf bases and are terminated by a great fan of leaves. The leaves are 1–1.5 m. long, 5–6 cm. broad, and serrate on the margin. During the rainy season the handsome, long-stalked, plume-like inflorescence, up to 5 dm. long, rises above the leaf-fan and becomes very conspicuous. The plant is unisexual. The male and female ones differ appreciably in shape, color and duration of their plumes. The plant spreads onto cleared land by sending out stiff, slender, sharp-pointed rhizomes, 1–2 cm. thick. These grow across the surface of the ground and only when several meters from the mother plant do they strike root and begin upward growth. The plant is widely distributed in tropical America. (Fl. C. Z. p. 73). *Johnston 210; Erlanson 511; Harlow 39.*

HYPARRHENIA RUFA (Nees) Stapf

In January 1946 found growing in a damp place in disturbed soil at the head of E. M. Beach and in a damp place in a clearing at the edge of the forest by the Mata Puerco Bridge. The plant is an emigrant from the Isthmus. A native of the Old World introduced into the American tropics as a forage grass. *Johnston 852, 1187.*

Ichnanthus pallens (Sw.) Munro

Growing in partially shaded open places in and about forests and now becoming common in sheltered places at roadsides in the forested parts of the island. Widely distributed in tropical America. (Fl. C. Z. p. 81). *Johnston 682, 905; Erlanson 163, 208, 237.*

ISCHAEMUM CILIARE Retz.

In January 1946 frequent as a weed in the lawn at Main Camp and well established on the fill along Red Hill Grade. A recent emigrant from the

Isthmus. A native of the Old World, now established in a few places in tropical America. (Fl. C. Z. p. 86). *Johnston 997, 1311.*

Jouvea straminea Fourn.

Locally abundant in sand along the tidal inlet at the mouth of the Rio Marino. The species ranges along the coast from Mexico to Panama. *Johnston 1259.*

Lasiacis oaxacensis (Steud.) Hitchc.

A grass with branching, elongate, trailing or clambering stems which before the advent of the Army on San Jose was apparently only occasional in thickets or along forest margins. Roadsides through thicket and open forest, and trails cut through thicket proved a very congenial habitat for it, and by the end of 1945 it was one of the commonest grasses in these situations. Unused trails in thicket areas quickly become choked, waist-high, with a tangle of its slender stems. During the first half of the dry season it produces a large, loose panicle bearing first purplish but finally jet-black spikelets, 3–4 mm. in diameter. The leaves, 15–20 cm. long and 10–15 mm. broad, are usually abundantly and minutely spotted with brown on the under side. This spotting is very evident in fresh leaves but disappears in herbarium material. The species ranges in the West Indies and from Mexico to Peru. (Fl. C. Z. p. 81). *Johnston 681, 904, 1032; Erlanson 308.*

Lasiacis procerrima (Hack.) Hitchc.

A coarse grass frequent at intervals at the roadside along the Loop Road from Canyon Road to east of Red Hill, and less commonly along Dead End Road and Bald Hill Road. Near the junction of the Loop and Canyon Road the plant occurs in open places in undisturbed thicket, but elsewhere it was seen only in disturbed soils along roads. The stems of the plant grow in a loose clump and are terminated by a very large, much branched, open panicle. They grow 1–2 m. tall and have leaves 15–30 cm. long and 3–5 cm. wide, which are broadest just above their conspicuously cordate and clasping bases. The panicle is usually about 3–5 dm. long and nearly as broad. The species ranges from Mexico to Peru. (Fl. C. Z. p. 81). *Johnston 296, 442; Erlanson 383.*

Lasiacis ruscifolia (HBK.) Hitchc.

Occasional in thickets and in open forests on the northern half of the island, but most abundant on the eastern peninsula and especially about areas of thin soil. It resembles in appearance a small bamboo and usually develops a few erect, leafy stems 1.5–2.5 m. tall. Its period of flowering and fruiting appears to extend from September into February. The plant is widely distributed in tropical America. (Fl. C. Z. p. 82). *Johnston 162, 187, 1130, 1255; Harlow 73.*

Lasiacis scabrior Hitchc.

Seen only once. It is a coarse grass forming rounded clumps, 3–6 dm. tall, at the side of East Road along the southern boundary of Area 8A. The species ranges from Guatemala to Ecuador. *Johnston 548.*

Lasiacis sorghoidea (Desv.) Hitchc. & Chase

Occasional at roadsides along the East Loop and along Dead End Road and Bald Hill Road. In Area 11B it was found growing through thickety growth in moist soil at the margin of streamside forest. It resembles *L. ruscifolia* in having the habit of a small bamboo, but has weaker canes which branch more freely and tend to lean on or scramble up through adjacent vegetation. It also differs from that species in having the leaves soft-hairy beneath and in having a later season of flowering. The stems become 2–4 m. long. Flowering and fruiting begin in January and continue through February. The species is widely distributed in tropical America. (Fl. C. Z. p. 82). *Johnston 1078, 1272.*

Leptochloa filiformis (Lam.) Beauv.

Growing on thin soil in an open place in the deciduous forest back of East Harbor. The species is very widely distributed in America. (Fl. C. Z. p. 74). *Johnston 781.*

Leptochloa virgata (L.) Beauv.

In January 1946 growing as a weed in the lawns at Main Camp and along the roadside between the Goat Barn and the Cross Roads. The plant is a recent emigrant from the Isthmus. The species is widely distributed in tropical America. (Fl. C. Z. p. 74). *Johnston 985, 1123.*

Olyra latifolia L.

Frequent in thickets and forest on the northern half of the island. Resembling a small bamboo in habit. In shaded forests it has a few erect or outcurving stems, 1–2.5 m. tall. In thickets it clambers and may reach 3 m. or more in height. Its largest stems are 5–10 mm. thick. The species is widely distributed in tropical America. (Fl. C. Z. p. 84). *Johnston 100. 462, 445; Erlanson 185, 250, 305.*

Oplismenus Burmanni (Retz) Beauv.

An abundant and characteristic grass of the deciduous forests, especially those on the eastern peninsula of the island. It is common to find large areas of the thin soil in these forests loosely carpeted with the trailing leafy stems of this small herb. Occasional colonies are found in evergreen forests, but almost always where the canopy is thin and usually also where the soil is shallow. On Bald Hill it is frequent in sheltered open places about the fringe of the forest margining the grassland. This plant is said to be of Old World origin and to have been introduced into America in post-Columbian times. Its behavior on San Jose, however, is that of a native plant and an old member of the flora. It has not spread along roads or appeared as a weed in the Camp areas. The species is widely distributed in the tropics of both hemispheres. (Fl. C. Z. p. 83). *Johnston 158, 891, 1167.*

Oryza sativa L. Rice

In January 1946 a number of fruiting plants were growing on the rubbish piles at the Goat Barn. (Fl. C. Z. p. 75).

Panicum fasciculatum Sw.

In January 1946 an occasional weed in disturbed soil along the Air Strip and near by along East Road and about the Rock Crusher. Erlanson first

collected the plant in this area in July 1945. It appears to be a recent emigrant from the Isthmus. The species is widely distributed in tropical America. (Fl. C. Z. p. 79). *Johnston 847, 1104; Erlanson 451.*

Panicum Haenkeanum Presl

Seen only once. A few colonies were found in partial shade at the edge of the forest margining the great fern-thicket at the north boundary of Area 3A. The species ranges from Mexico to Venezuela. (Fl. C. Z. p. 80). *Johnston 1108.*

Panicum hians Elliott

In January 1946 a few fruiting plants of this species were found about the Goat Barn. The species ranges from the Carolinas to Oklahoma and south to Florida, Texas and adjacent Mexico, and has not previously been reported from the tropics. It was apparently introduced on San Jose in unclean hay from the United States. *Johnston 1238.*

Panicum laxum Sw.

Occasional as a weed in the lawns at Main Camp in January 1946. The plant is evidently an emigrant from the Isthmus. Ranging widely in tropical America. (Fl. C. Z. p. 80). *Johnston 896, 994.*

Panicum maximum Jacq. Guinea Grass

A very coarse tufted grass growing in clearings and along the road back of Main Beach. Forming large leaf-clumps 10–18 dm. tall and sending up panicles over 25 dm. in height. A few small plants of the species were observed in November 1944. By January 1946 the plants had increased in number and many had become large in size, but they were still confined to the relatively small area just east and north of the Machine Shop. The species is clearly an emigrant from the Isthmus. A native of Africa introduced into the American tropics as a forage grass. (Fl. C. Z. p. 80). *Johnston 1178; Erlanson 336.*

Panicum molle Sw.

Growing in thin soil in openings at the summit of the sea cliffs at East Harbor. Andersson found the plant along the same coast farther north. The species is widely distributed in tropical America.. *Johnston 182; Erlanson 437; Andersson.*

Panicum pilosum Sw.

Growing in wet soil along partially shaded streams and in moist places at forest margins in all parts of the island. The species ranges widely in tropical America. (Fl. C. Z. p. 80). *Johnston 26, 457, 632, 1064; Erlanson 316, 343, 559; Harlow 86.*

Panicum pulchellum Raddi

Occasional, but at times locally abundant, in damp soil in streamside forests. Widely distributed in tropical America. (Fl. C. Z. p. 79). *Johnston 1136, 1274; Erlanson 170.*

PANICUM PURPURASCENS Raddi PARA GRASS

In January 1946 growing as a weed in the grassy courts at the hospital at Main Camp. Evidently an emigrant from the Isthmus. Widely distributed in the tropics. An important forage grass in warm countries. (Fl. C. Z. p. 80, sub *P. barbinode*). *Johnston 1205.*

Panicum Rudgei R. & S.

A frequent and rather conspicuous plant in the grassland on Bald Hill. It has very stiffly and offensively bristly stems which, growing 1–2.5 m. long and frequently leaning on or scrambling through other grasses, reach 1–1.5 m. in height. It is the only plant which has spread from the grassland as a result of Army operations on the island. In January 1946 it had appeared, become well established, and was fruiting in the parts of Area 11A where thicket had been burnt over during the preceding April. Widely distributed in tropical America. (Fl. C. Z. p. 80). *Johnston 324.*

PANICUM TENNESSEENSE Ashe

Numerous scattered vigorous plants, some of them abundantly fruiting, were found well established in the disturbed soil of the clearing about the Goat Barn in January 1946. The species was obviously introduced from the United States, probably in unclean hay shipped from New Orleans. A widely distributed plant in eastern and southern United States not known south of northern Mexico. *Johnston 1156.*

Panicum trichoides Sw.

Growing on thin soil about rock exposures on the ridge at Max Point and in similar situations on a small ridge near the Engineer Camp. The species is widely distributed in tropical America. (Fl. C. Z. p. 79). *Johnston 378, 977.*

Paspalum clavuliferum Wright

Open places with thin soil at the summit of the sea cliffs at East Harbor. Mexico and the West Indies south to Colombia and Brazil. *Johnston 173.*

Paspalum conjugatum Bergius

Growing on moist gravel and sand bars along the Rio Marino near Red Hill and associating with introduced weeds on the fill at the foot of Red Hill Grade and in the lawns at Main Camp. Widely distributed in the tropics. (Fl. C. Z. p. 77). *Johnston 631, 996, 1204, 1312; Erlanson 168, 317.*

Paspalum decumbens Sw.

Collected by Erlanson along a road in Area 4B. Widely distributed in the American tropics. (Fl. C. Z. p. 78). *Erlanson 533.*

Paspalum multicaule Poir.

Occasional in the Bald Hill grassland and on a steep slope with thin soil near Orangetree Beach. Widely distributed in tropical America. (Fl. C. Z. p. 77). *Johnston 24, 883, 949.*

Paspalum microstachyum Presl

Growing in open places near a stream in rather thin soil on the eastern peninsula and along the margin of the swamp at Main Beach. Ranging from Guatemala to Ecuador and Brazil. (Fl. C. Z. p. 78). *Johnston 163, 865; Harlow 52.*

Paspalum nutans Lam.

A common grass about the summit of sea cliffs and in open places on steep seaward slopes. It is also common in open places in the forests. In 1944 it appeared promptly and soon covered many banks of raw soil along the new roads of the island, but a year later was much less common in such situations. As a ground-cover it proved very successful about the Range Office, where a fine growth of it, originating from transplants set out in November 1944, was still thriving over a year later. The plant has numerous trailing and rooting stems and forms a loose mattress-like growth. The species ranges from Central America to Brazil. (Fl. C. Z. p. 78). *Johnston 217, 932, 1081, 1225.*

Paspalum paniculatum L.

Collected by Erlanson in waste places at the Navy Station in June 1945 and by Harlow at Main Beach in September 1945. It was found along the roads back of Main Beach in December of the same year. It is apparently a recent emigrant from the Isthmus. The species is widely distributed in the American tropics. (Fl. C. Z. p. 78). *Johnston 864; Erlanson 359; Harlow 46.*

Paspalum plicatulum Michx.

Locally common near the forest margin at the west end of the Bald Hill grassland. In January 1946 one large plant was found growing on the bank of fill along the Rio Mata Puerco by the Goat Barn. The species ranges from the United States to Argentina. (Fl. C. Z. p. 78). *Johnston 40, 1209, 1236.*

Pennisetum setosum (Sw.) L. Rich.

First observed in November 1944 at the Navy Station, where it was frequent in the cleared land about the head of the sea cliffs. It was still present there over a year later. Another colony of the plant was found in disturbed soil along the Air Strip in January 1946. It appears to be a recent emigrant from the Isthmus. The species is widely distributed in the American tropics. (Fl. C. Z. p. 83). *Johnston 708, 1022.*

Pentarrhaphis scabra HBK.

Growing in open places on thin soil about the head of the sea cliffs at East Harbor. Ranging from Mexico to Colombia. The species has not previously been reported from Panama. *Johnston 174.*

Pharus latifolius L.

Occasional on the shaded forest floor in Area 7A and on the wooded slopes of Red Hill. It is locally very common about the junction of the Loop Road and Little Butch Trail. The species ranges from Central America and the West Indies south to Peru and Brazil. (Fl. C. Z. p. 75). *Johnston 459; Erlanson 345.*

POLYTRIAS PRAEMORSA (Nees) Hackel JAVA GRASS

Planted as a lawn-grass at the Navy Station early in 1944 and at Main Camp late in 1945. The species is a native of the East Indies. (Fl. C. Z. p. 84, sub *P. amaura*). *Johnston 1091.*

SETARIA GENICULATA (Lam.) Beauv.

A weed well established about the Navy Station where it was first collected by Erlanson in May 1945. In January 1946 it had become an occasional weed in the lawns at Main Camp. The plant is evidently an emigrant from the Isthmus. The species is widely distributed in America. (Fl. C. Z. p. 83). *Johnston 986; Erlanson 129, 362, 593.*

Setaria paniculifera (Steud.) Fourn.

Growing on a bank along the Marino just above Red Hill Bridge and along the East Loop at the roadside a short distance north from East Road. The species ranges from Mexico and the West Indies south to northern South America. (Fl. C. Z. p. 83). *Johnston 376.*

Setaria tenax (L. Rich.) Desv.

This grass was found in 1944 growing as an indigenous plant in areas of thin soil in the vicinity of East Harbor. Gravelly shoulders of roads and the slopes of fills have proved congenial new habitats. In March 1945 it was found along the road near the Red Hill Bridge and a few scattered plants were noted along the Air Strip. In May Erlanson collected it along the road near Main Camp. In January 1946 it was frequent along the roads about the Camp area and on to the Cross Roads. It was even more common along the East Road and about the Air Strip. The species is widely distributed in tropical America. (Fl. C. Z. p. 83). *Johnston 626, 674; Erlanson 74, 252, 454; Harlow 26.*

SETARIA VIRIDIS (L.) Beauv.

Growing in the old corral at the Goat Barn in January 1946. This annual weed is not reported from Panama and was probably introduced onto San Jose in unclean hay shipped from the United States. A European species now widely distributed in America as a weed. *Johnston 1155.*

SORGHUM HALEPENSE (L.) Pers. JOHNSON GRASS

Locally well established along the roadside near the Goat Barn, where it was first collected by Erlanson in May 1945. A species of the Mediterranean region now widely spread in America. (Fl. C. Z. p. 86). *Johnston 1122; Erlanson 187, 464.*

SORGHUM VULGARE Pers.

In January 1946 two cultivated forms of this species, Kafir and Broom Corn, were found growing on debris at the Goat Barn.

Sporobolus ciliatus Presl

Growing on thin soil in openings at the summit of the sea cliffs at East Harbor. Central America and south to Brazil. (Fl. C. Z. p. 73). *Johnston 181.*

Sporobolus indicus (L.) R. Br.

In 1944 this plant was seen only at the Navy Station, where a number of thrifty individuals were growing in the clearing. In March 1945 it had appeared in disturbed soils along roads in the vicinity of Main Camp, and by January 1946 it was present in disturbed soil near the Garbage Dump, about the Goat Barn and on the fill along Red Hill Grade. The plant gives every evidence of being a recent emigrant from the Isthmus. The species is widely distributed in tropical America. (Fl. C. Z. p. 73). *Johnston 1237; Erlanson 197, 352, 364.*

Sporobolus virginicus (L.) Kunth

Growing on beaches just below the high-tide line. It is most abundant at the mouth of the Rio Marino. Small colonies of the grass were observed at Main Beach, in Navy Cove, and at the west end of Canyon Road. Widely distributed along coasts in tropical America. (Fl. C. Z. p. 73). *Johnston 1265.*

Stenotaphrum secundatum (Walt.) Kuntze St. Augustine Grass

Growing on the sandy beach along the tidal inlet at the mouth of the Rio Marino, under the palms at Orangetree Beach, and on a ledge on the sea cliffs just south of the Engineer Camp. Ranging from the United States to Argentina. (Fl. C. Z. p. 84). *Johnston 218, 1266.*

Streptogyne crinita Beauv.

Frequent on the shady floor of forests in all parts of the island. Ranging from Mexico to northern Brazil. (Fl. C. Z. p. 72). *Johnston 433, 728, 1115.*

Trachypogon secundus (Presl) Scribn.

The dominant grass over most of the grassland on Bald Hill, and occurring naturally nowhere else on the island. Clumps of this grass, taken from Bald Hill, were transplanted on eroding banks at the Cross Roads and at Main Camp during 1945 and were still alive in February 1946. The species ranges from Mexico to Panama. (Fl. C. Z. p. 86, sub *T. Montufari*). *Johnston 431; Erlanson 129, 578.*

Trichachne insularis (L.) Nees

Occasional in disturbed soil in clearings along the Air Strip and along adjoining portions of East Road, where it was first discovered in January 1946. I believe it to be a recent emigrant from the Isthmus. The species is widely distributed in the warmer parts of America. (Fl. C. Z. p. 76). *Johnston 1021.*

Tripsacum lanceolatum Rupr.

A few colonies of this coarse grass are localized on scattered areas of thin soil, in openings in deciduous forest, on the eastern peninsula. The species ranges from Mexico to Panama. (Fl. C. Z. p. 86, sub *T. dactyloides*). *Johnston 965.*

Uniola Pittieri Hackel

Growing in beach sand. Its habitat is best developed at Playa Grande and it is most abundant there, particularly in the vicinity of the mouth of the Rio Marino. Distributed along the Pacific Coast from Mexico to Ecuador. (Fl. C. Z. p. 73). *Johnston 244; Erlanson 135, 434.*

CYPERACEAE

(Identifications by H. K. Svenson)

Bulbostylis junciformis (HBK.) Lindman

Occasional among the grass clumps in the Bald Hill grassland. Ranging in Cuba, Honduras, Panama and northern South America. (Fl. C. Z. p. 90, sub *Stenophyllus junciformis*). *Johnston 48; Erlanson 481; Harlow 70.*

Cyperus compressus L.

In December 1945 a single plant was found at the roadside just back of Main Beach. Its associates, as well as its behavior, suggest that it may have been a recent introduction from the Isthmus. The species is widely distributed in the tropics. (Fl. C. Z. p. 88). *Johnston 860.*

Cyperus diffusus Vahl

Collected by Erlanson on the rocky open coastal bluffs at East Harbor and by Andersson farther north on the east coast of the island. The species is widely distributed in the warmer regions of both hemispheres. (Fl. C. Z. p. 89). *Erlanson 245, 449; Andersson.*

Cyperus esculentus L.

A weed, obviously introduced from the Isthmus, occasional in the lawns at Main Camp in January 1946. The species is widely distributed in the warmer parts of the world. *Johnston 998.*

Cyperus ferax L. C. Rich.

Occasional in damp soil, formerly found chiefly along the coast, but now appearing along roadside ditches and on moist soil in clearings. The plant is widely distributed in the warmer parts of the world. (Fl. C. Z. p. 88). *Johnston 90, 91, 393, 956, 1089, 1298, 1313; Erlanson 86.*

Cyperus flavus (Vahl) Nees

Occasional in the Bald Hill grassland. Elsewhere on the island seen only on the eastern peninsula where it grew along a small ravine in an area of thin soil. Ranging from Mexico to Argentina. (Fl. C. Z. p. 88, sub *C. caracasanus*). *Johnston 38, 151, 1211; Erlanson 429.*

Cyperus hermaphroditus (Jacq.) Standley

Frequent in damp soil in the bottom-land about the Camp Valley forest back of the E. M. Barracks. Ranging from Mexico to Argentina. (Fl. C. Z. p. 88). *Johnston 394, 395; Harlow 29.*

Cyperus ligularis L.

Occasional on cliffs, on gravelly places on steep slopes, and on barren islets along the coast. It is at times also found on rocky crests of ridges and in areas of thin soil in the interior of the island. From these natural habitats the species has spread to the slopes of fill along roads and has become more generally distributed than formerly. The species is widely distributed along the coast of tropical America. (Fl. C. Z. p. 88). *Johnston 1047.*

Cyperus Luzulae (L.) Retz.

Collected along the Rio Marino in Area 7A and on fill along the Rio Mata Puerco at the Goat Barn. The species is widely distributed in tropical America. (Fl. C. Z. p. 89). *Johnston 694, 1148.*

Cyperus panamensis (Clarke) Britton

Collected January 1946 in the lawn at the head of the cliff near the officers' cottages at Main Camp, where it may have been introduced along with grass cuttings from the Isthmus or may have spread from possible indigenous colonies on nearby cliffs. In any case the species is native on the island. In 1852 Andersson collected the plant on the northeastern coast. The species ranges from Guatemala to Ecuador. The variety *ramigerus* Kükenthal appears to have been largely based upon Andersson's material from San Jose. (Fl. C. Z. p. 88). *Johnston 1002; Andersson.*

Cyperus polystachyus Rottb.

Noted only at Red Hill where it grows on fill near the foot of the grade. It was first seen in February 1946, probably as a recent introduction to the island, for it was associated with a number of other species which were clearly recent emigrants from the Isthmus. The species is widely distributed in the warmer parts of the world. (Fl. C. Z. p. 88, sub *C. odoratus*). *Johnston 1314.*

Cyperus rotundus L.

Collected by Erlanson, June 22, 1945, "in sandy places near Main Beach." A weedy introduction from the Isthmus. The species is widely distributed in the warmer portions of the world. (Fl. C. Z. p. 88). *Erlanson 332.*

Cyperus simplex HBK.

Growing in Area 7A and on the slopes of Red Hill along wooded streams and in wet places in the forest. The species is widely distributed in tropical America. (Fl. C. Z. p. 89). *Johnston 105; Erlanson 166, 346.*

Cyperus tenerrimus Presl

Collected by Erlanson in open places on the rocky coastal bluffs at East Harbor. The species ranges from Mexico to Colombia. (Fl. C. Z. p. 89). *Erlanson 251, 450.*

Dichromena ciliata Vahl

Collected along the stream at Mango Beach, along the Rio Marino near Red Hill, in a roadside ditch near the Goat Barn, on the bluffs at East Harbor, and in the grassland on Bald Hill.

The species is widely distributed in tropical America. The plants from Bald Hill have the leafy bracts of the inflorescence white on their upper surface below the middle. They are transitional to *D. colorata* (L.) Hitchc., according to Dr. Svenson. (Fl. C. Z. p. 91). *Johnston 37, 243, 1149; Erlanson 245, 248, 293, 323; Harlow 63.*

Eleocharis interstincta (Vahl) R. & S.

Collected by Erlanson in a water-filled pot-hole located in the bedrock of the thin soil area at East Harbor. The species ranges in the warmer parts of America. (Fl. C. Z. p. 89). *Erlanson 460.*

Fimbristylis annua (All.) R. & S.

A very slender, clearly annual form of this plant grows during the rainy season on thin soil about the head of the sea cliffs at East Harbor. A more robust perennial form, which Dr. Svenson identifies as the variety *diphylla* Kükenthal, behaves as an introduced plant. In May 1945 Erlanson collected it on cleared land near Main Camp and along the Marino near Red Hill. In December 1945 I found it common at Main Beach, in the lawn at Main Camp, and along the fill at the foot of Red Hill Grade. The species is very widely distributed. (Fl. C. Z. p. 90, sub *F. diphylla*). *Johnston 169, 869; Erlanson 165, 198.*

Fimbristylis miliacea (L.) Vahl

Apparently a recently introduced plant from the Isthmus. In January 1946 I found it associating with other immigrant weeds at Main Beach, along the road near the Physiological Laboratory, and on the fill at the foot of Red Hill Grade. Erlanson has collections, made as early as May 19, 1945, from the last of the above-mentioned stations. The species has a very wide distribution in both the Old World and the New. (Fl. C. Z. p. 90). *Johnston 868, 1121; Erlanson 167, 315, 536.*

Fimbristylis spathacea Roth.

Growing in a low place at the west end of Main Beach. Only two plants seen. The species is very widely distributed along tropical beaches. (Fl. C. Z. p. 90). *Johnston 867.*

Fimbristylis spadicea (L.) Vahl

Common in the sand about the tidal inlet at the mouth of the Rio Marino. Widely distributed along coasts in America. (Fl. C. Z. p. 90). *Johnston 1267; Erlanson 435.*

Kyllinga brevifolia Rottb.

Found only in an abandoned clearing near the Mata Puerco Bridge. The species is very widely distributed. *Johnston 1188.*

Kyllinga odorata Vahl

Frequent in the grassland on Bald Hill. The species is very widely distributed. (Fl. C. Z. p. 87). *Johnston 39.*

Rynchospora armerioides Presl

Abundant on grassy open places on thin soil back of the sea cliffs at East Harbor. A slender herb 15–40 cm. tall with a basal tuft of leaves and a scape-like peduncle that is terminated by a dense cluster of spikelets surrounded by short, broad, imbricate bracts. The plant has the appearance of a member of the *Compositae*. I found the species fully mature, and because of its abundance very conspicuous at the end of December. The species is known from Panama and tropical South America. (Fl. C. Z. p. 91). *Johnston 817.*

Rynchospora cephalotes (L.) Vahl

A species of shaded forest floors, frequent in all parts of the island. Ranging from Mexico and the West Indies south into northern South America. (Fl. C. Z. p. 91). *Johnston 24; Erlanson 270; Harlow 91; Andersson.*

Rynchospora micrantha Vahl

Growing about large rocks near summit of Goat Hill. Harlow collected it at East Harbor. The species ranges in Central America and the West Indies. (Fl. C. Z. p. 92). *Johnston 307; Harlow 72.*

Rynchospora mexicana Steud.

Common locally on the flat rocks at the head of the sea cliffs at East Harbor. A species of southern Mexico, heretofore unreported from Central America. *Johnston 179.*

Scleria bracteata Cav.

A coarse sedge scrambling 3 m. high in bushes at the margin of the grassland on Bald Hill. Erlanson reports it as clambering to 4.5 m. in openings of the forest in Area 3A. The plant is not uncommon in forests on the northern half of the island. The species is widely distributed in tropical America. (Fl. C. Z. p. 92). *Johnston 892; Erlanson 92.*

Scleria interrupta L. C. Rich.

Growing on steep slopes with thin soil near Orangetree Beach and on thin soil at the summit of the sea cliffs at East Harbor. Ranging from Mexico and the West Indies south into northern South America. *Johnston 188, 948.*

Scleria micrococca (Liebm.) Steud.

Growing in the grassland on Bald Hill and near East Harbor. Ranging from Mexico and Cuba south to Brazil. (Fl. C. Z. p. 92, sub *S. Liebmanni*). *Johnston 44; Harlow 76.*

Scleria mitis Berg.

Forming large clumps 18–29 dm. tall along a stream in the eastern portion of Area 8D. The species is widely distributed in tropical America. (Fl. C. Z. p. 92). *Johnston 1393.*

Scleria pterota Presl

Frequent in moist, shaded places at the margin of the forest fringing the Bald Hill grassland. A form with black achenes, the variety *melaleuca* Uittien, is frequent along the Rio Marino near Red Hill. Widely distributed in tropical America. (Fl. C. Z. p. 92). *Johnston 21, 106; Erlanson 278, 322.*

Scleria secans (L.) Urban SAW GRASS

A clambering sedge with sharp-edged stems and leaves that cut painfully the face or hand brushed against them. Its many slender stems grow up through vegetation at the margin of forest and thickets, frequently attaining a height of 3–4 m. Before the advent of the Army the plant was probably only an occasional nuisance on the island. It was capable, however, of appearing promptly and growing rapidly in disturbed soils in any sunny place in and about the forests. A year after the Army arrived on San Jose it had become common along most roads, not only in forests, but in thicket areas as well. It now clambers abundantly in the second growth along the roads. Along the shoulders of some roads it forms pure stands, hedge-like in appearance, that present a formidable barrier for anyone desiring to leave the road and reach the forest or thicket beyond. Roads through thicket or

forest, if left unused through a rainy season, are commonly choked in many sections by head-high masses of its cutting stems and leaves. The clearing of the land and the disturbing of the soil have favored this obnoxious plant. It is now very common and a veritable pest in those parts of the island where man has most affected the native vegetation. The species is widely distributed in tropical America. (Fl. C. Z. p. 92). *Johnston 200, 440; Erlanson 17.*

Scleria setacea Poir.

Grassy open areas on thin soil above the sea cliffs at East Harbor. Ranging from eastern United States south to northern South America. (Fl. C. Z. p. 92). *Johnston 828.*

PALMAE

Astrocaryum

The stones from the fruit of this palm (Plate 9, fig. 4) are common objects on the beaches of Bodega Bay. They are woody, symmetrical, egg-shaped bodies, commonly about 2.5–3 cm. long and 1.5–2 cm. thick, which bear three conspicuous pits or holes nearly equally spaced about the larger rounded end. Except when very old and worn, they are black in color. Occasional specimens have adhering dusky fibers. About their pits such specimens show in varying degrees the characteristic pattern of radiating fibers that is distinctive of the stones of *Astrocaryum.* The palm producing these common drift fruits does not grow on San Jose but perhaps may occur on some of the other Perlas Islands. It may represent *A. Standleyana* Bailey of the Canal Zone or even some other species of western Colombia and Ecuador. It is an erect-growing palm with large pinnate leaves and is very spiny, especially on the trunk. The wood is extremely hard and very black and is used in making canes and other objects. In the Canal Zone it is the plant usually referred to as "Black Palm." According to Guppy the stones of *Astrocaryum* have been found in beach drift at both ends of the Canal Zone and on Jamaica and Trinidad.

Bactris balanoides (Oerst.) Wendl. Black Palm

A slender-stemmed palm armed on all parts with an abundance of straight, black, needle-like spines 3–7 cm. long. It is very widely distributed on the island, forming colonies in moist soils, on terraces along streams, and in springy places on slopes. The slender, hard stems are erect, 2.5–5 cm. thick, commonly 2.5–5 m. long, and marked every 1–2 dm. by pale leaf scars and concentrations of black spines. They arise at intervals of 1–5 dm. along a very coarse, shallowly buried rootstock which may be much branched and extend through many square meters of soil. Many, if not all the palms in a colony, therefore, may be parts of a single plant. The crown consists of 6–8, graceful, pinnate fronds, 1–2 m. long and 8–11 dm. broad, that bear spines on petiole, rhachis and leaf-segments. The branched inflorescence is produced in a tough, stalked, excessively spiny, boat-shaped spathe developed on the trunk just below the functional leaves. The fruit, matured abundantly during the middle of the dry season, is produced in dense pendent globular clusters, 1.5–2 dm. in diameter. It is ellipsoidal, 3.5–5 cm. long, about 3 cm. thick, purplish when ripe, and has a tough fibrous rind and, sur-

rounding the stone, a pale juicy flesh with a refreshing, slightly acid flavor somewhat suggestive of strawberries. The black ovoid stones 2.5–2.9 mm. long, are occasionally washed up on the beaches (PLATE 9, FIG. 2). They are strongly roughened and somewhat oblique on one side at the larger basal end and have three conspicuous holes or pits, two situated a centimeter above the base with the remaining one less than half that distance above it.

Viewed dispassionately, this palm is decorative and the curves of its graceful leaves do add beauty to many streamside forests. Such charms and beauty of line as it may possess, however, are best enjoyed in photographs. He who, while cutting a machete-path through a thicket of it, has had his knife glance off dangerously from its stems, or has had the spiny trunk and leaves descend upon him, will never be in any mood for aesthetic appraisal of its charms. The newcomer to the island, when for the first time he has inadvertently kicked a fallen leaf or trunk of this spiny plant, instantly knows he has met an enemy. If, while descending a stream bank, he loses his footing and is so ill-fated as to grab one of its spiny trunks, he knows the plant for the vicious, treacherous thing it is. Its spines go through clothing and shoes with ease, all too often they pierce the skin and break off to cause a painful and festering sore and frequently aching joints. Perhaps it is because the island it so relatively free of other obnoxious plants that the spines of this palm seem so formidable. In any case, I am sure San Jose would be a more pleasant place without them.

The species is known only from Costa Rica and Panama, but is very closely related to *B. major* Jacq. of northern Colombia and perhaps is not really distinct from it. Among army personnel on San Jose it is universally called "Black Palm." That name is very loosely applied to a large number of very different palms in the tropics, but I can find no record of it having been previously applied to members of the genus *Bactris*. The Spanish-speaking workmen on the island refer to the plant as "Caña brava" or "Palma brava." *Johnston 266, 816; Erlanson 510; Harlow 45.*

Cocos nucifera L. COCONUT PALM

Coconut palms form groves on the beaches in Bodega Bay, especially on the barrier beaches at Main Beach, Long Beach and Orangetree Beach. A small but good growth of them occurs on E. M. Beach, but elsewhere on the island, particularly so on the east coast, they are infrequent, some beaches having a few, but most being entirely without them. On the great stretch of sandy coast at Playa Grande, which would seem to be a favorable habitat for the plant, I was able to locate only four widely separated individuals of the species. With the single exception of Orangetree Beach, the palm is present in large numbers only on those beaches having north and northwesterly exposure, or, in other words, those on which the largest amount of drift accumulates. Most of the palms are old trees. Young plants and seedlings are rare.

The species is widely distributed on coasts in the tropics. The best evidence indicates that it was introduced into America from the Old World in post-Columbian times. The coconut, protected by its tough, thick husk, can float in the sea for long periods and still retain the ability to germinate and establish a new plant if washed up on a suitable shore. The island plants probably had such an origin. An occasional coconut and much debris from the palm is to be found in the drift washed up on the beaches. (Fl. C. Z. p. 97).

Corozo oleifera (HBK.) Bailey OIL PALM

Known on San Jose only on the point of land northeast from the northwest end of the Air Strip, formerly reached by the now abandoned and overgrown Mortar Road. At that place fully a dozen large plants grow in thicket on a ledge overlooking the sea. This is a surprising habitat for the palm, since it is usually found in shaded, swampy ground. The coarse trunks, covered with persistent leaf-bases, lounge on the ground and curve upward at their ends to bear a large number of feathery pinnate leaves 3–4.5 m. long. The petioles have thorny margins. The inflorescences are rounded, compact masses of finger-like branches, growing crowded among the petiole-bases. The fruit is an ellipsoidal red berry, produced in large numbers. The species ranges from Costa Rica south into northwestern South America. (Fl. C. Z. p. 99, sub *Elaeis melanococca*). *Johnston 780.*

MANICARIA SACCIFERA Gaertn.

The large seeds of this palm (PLATE 9, FIG. 3) were found repeatedly in the drift on the beaches of Bodega Bay and also on E. M. Beach. They were found during all of my three visits to the island, but in greatest number in January 1946. Many were then alive and viable, and, interestingly, had the fresh appearance of only recently matured seeds. Some even had fibers of the husk still adhering to their shell. The indications are that they had some near-by source, probably on some of the other Perlas Islands, since I do not believe the palm grows on San Jose. The palm producing them is an unarmed tree up to 10 m. tall, usually forming colonies near the shore or in swamps close to the sea. It has very large and distinctive leaves, these being nearly entire, i. e., not broken up into segments as in most palms, and as much as 10 m. long and 2 m. wide. The globular single-seeded fruit, 7–8 cm. in diameter, is covered with coarse pyramidal tubercules. The seeds have a flattened, nearly circular attachment scar about 8 mm. broad, and near this scar are usually obtuse-angled. They are 3..5–5 cm. in diameter. When fresh they have a thin brown outer coat, but under beach conditions this soon flakes off to expose a thin, brittle, somewhat siliceous inner shell, commonly gray though sometimes darkening in age, which is marked with dusky, vein-like lines.

The species is known to grow in the southern West Indies and along the Caribbean coast of Central and northern South America, but has not previously been reported from the Pacific coast of America. Its distinctive seeds are well-known elements in the West Indian drift, and some of them, carried by the Gulf Stream, have been picked up even on the coast of Scotland. (Fl. C. Z. p. 96).

PHYTELEPHAS SEEMANNII Cook? IVORY PALM

Dead hollow seeds of this palm (PLATE 9, FIG. 1) were picked up repeatedly in the beach drift at E. M. Beach and on the beaches in Bodega Bay. Their source is unknown. The palm, which grows in damp places in valleys and along the coast, is not common in Panama. It has a coarse trunk, frequently lounging on the ground, that bears a crown of leaves several meters long. The seeds are borne in large, tuberculate heads on or near the soil. They are at first filled with a liquid which thickens and eventually hardens and becomes ivory-like in appearance and texture. The seeds washed up on the

coast of San Jose do not have the ivory kernel. They are empty shells. They are irregular in size and form, but usually have a broad, rounded back and two distinctly flattened sides which converge towards a large perforated attachment scar. The shells are gray or slate-colored and siliceous in texture. Viewed laterally, with the scar downward, they measure 4.5–5.5 cm. high, 4.5–6 cm. broad, and 3.5–5 cm. thick. The attachment scar, 1–2 cm. long and 7–14 mm. broad, is usually elliptic and is invariably perforated by a large number of small holes like a salt-shaker. The dead seeds washed up on the beaches always have a large hole opening into their central cavity. This is 5–8 mm. broad and is always located about 5 mm. from the attachment scar.

Guppy reports many empty seeds of the Ivory Palm in the floating and stranded drift along the Guayaquil Estuary, Ecuador. He states that the sound seeds possess no floating power. (Fl. C. Z. p. 96).

Sabal Allenii Bailey — PALMA DE GUAGARA

Only a single individual of this palm is known on San Jose. It stands in a colony of *Bactris* just outside of the dense streamside forest in Area 11B, at the end of the principal jeep trail into that area. It is 15–18 m. tall and has a slender clean trunk 23 cm. thick, breast high. Its crown, composed of about 25 functional leaves and a few reflexed dead ones, is very open and roughly globular in form. The slender, unarmed petioles are about 2 m. long. The blade is nearly cordate in outline and 1.5–1.8 m. long. Its segments, separated down to within 2 dm. of their base, are stiff and diverging for nearly two-thirds of their length, but then they bend with their terminal portion becoming pendent and floppy in the breeze. The slender and very elongate inflorescences are 3.5 m. or more long. They are usually ascending and project well beyond the leaves.

Another example of the species formerly grew at the end of Grabby Clutch Jeep Trail, in the forest west of the Marino in Area 7A. It was apparently a shaded juvenile plant, without trunk, and its large leaves were said to spread widely with some of them practically flat on the ground. In mid-1944 it was uprooted and replanted at Main Camp, where I had a chance to study it before it died later that year.

Away from San Jose this palm is known only from the near-by island of Pedro Gonzales, where it was first discovered. It is said to be rather common at places in the interior of that island. In fact, as the boat plying between Balboa and San Jose passes Gonzales, one colony of them can be seen about what appears to be a small savanna on the crest of that island.

CYCLANTHACEAE

Carludovica palmata R. & P. — PANAMA HAT PALM

Only a single large colony was seen on the island. It is on a low bank along a stream in the forest near the northeast corner of Area 3C. The plant has no trunk and produces its small, palm like leaves on slender, erect petioles 1.5–2.5 m. long that spring directly from the soil. The leaf-blades, 3–5 dm., are split into four sections and suggest a Maltese Cross in form. The flowers are borne in a dense spike on a stalk arising from the soil. They produce long, filiform staminodes which remain for some time in a tangle about the

spike. On the island the plant had completed flowering when I first found it on April 6, 1945. The species ranges from Mexico to Peru. (Fl. C. Z. p. 100, plate 8). *Johnston 657.*

ARACEAE

Dieffenbachia DUMB CANE

A species of this genus, perhaps *D. longispatha* Eng. & Krause, is a common and characteristic plant along shaded streams on the island. It has very coarse stems 3–5 cm. thick, which creep on stream banks or on the muddy bottoms of slow streams and then curve upward to form an erect green trunk 3–5 dm. tall, terminated by a stiff cluster of large leaves. The leaf blades, 3–4 dm. long and 12–19 cm. broad, are broadest below the middle and have a rounded base and an acute tip. They are borne on a petiole 2–3 cm. long which is margined for three-fourths of its length. No flowering plants were seen. The juice of the plant is caustic and causes large blisters if it touches the skin. *Johnston 1165.*

Monstera pertusa (L.) deVriese

A root-climber occasional in forests in all parts of the island. The leaves are ovate and asymmetric in form, 20–45 cm. long and 12–30 cm. broad, and commonly have one or more large, unequal, transverse, elliptic perforations, 1–10 cm. long. The plant is readily recognized, for no other plant on the island has perforated leaf-blades. One plant with a maturing spadix 10–14 cm. long and 1.5 cm. thick was found Oct. 5, 1944. No other plant with either flowers or fruit was seen on the island. The species is widely distributed in tropical America. (Fl. C. Z. p. 102). *Johnston 11, 806, 916; Erlanson 558.*

Montrichardia arborescens (L.) Schott

Locally common in the vicinity of the stream mouth in the inner parts of the swamp back of Main Beach. A small colony grows nearby in springy ground by the stream near the northeastern corner of the yard at the Motor Pool. The plant was seen nowhere else on the island. Its habit is very distinctive. The erect, unbranched, usually thorny stems, 3–5 cm. thick and 2–2.5 m. tall, are terminated by a cluster of large leaves having triangular, arrow-shaped blades 3–4.5 dm. long. Early in April 1945 I found many plants in flower. The inflorescence, suggestive of that of a large Calla Lily, has a broad white spathe that is abruptly attenuate at the apex. Erlanson collected fruit near the end of May. The species is found in Central America, the southern West Indies, and in northern South America. (Fl. C. Z. p. 105, plate 9). *Johnston 662; Erlanson 225.*

Spathiphyllum phrynifolium Schott

A plant of wet ground along shaded streams, occasional in all parts of the island. It usually grows scattered, but at times may be locally present in some abundance, as, for example, at the water pump near the Navy Station. The plant has a cluster of leaves 5–15 dm. tall springing from a rhizone buried in the mud. The leaf has a petiole 3–7 dm. long which is margined to above the middle, and a blade, 3–6 dm. long and 1–2 dm. broad, that is rounded at the base and slenderly pointed at the apex. The inflorescence terminates a

slender peduncle about equalling the leaves in height. The spathe is leaf like. The spadix is white or slightly yellowish at anthesis and 6–10 cm. long and less than 1 cm. thick. At maturity it becomes 1.5–1.8 cm. thick. The fruit is rather dry when ripe and matures 1–2 seeds in each of its three cells. The species grows in Panama and possibly also north to Guatemala. (Fl. C. Z. p. 103). *Johnston 265, 1164, 1264; Erlanson 353; Andersson.*

Xanthosoma pilosum Koch

An herb 2–4 dm. tall, growing in wet, shaded forest soils. During October 1944 I found many flowering plants on the steep, wet, forested northwestern slope of Red Hill. I found it nowhere else on the island. Erlanson, however, collected fruiting specimens July 18, 1945, in the "valley below Camp." The tuft of leaves springs from a depressed corm which, when fresh, has an orange flesh and a milky juice. The cordate or sagittate leaf-blades, 1.5–3 dm. long and 1–2 dm. broad, are finely hairy beneath. The spathes are white, 9–15 cm. long, hairy outside and are borne on a hairy peduncle 1.5–2.5 dm. high. The species ranges from Mexico to Colombia. (Fl. C. Z. p. 105). *Johnston 104; Erlanson 486, 539.*

Philodendron Erlansonii, sp. nov. PLATE 13.

Planta altissime scandens; caulibus hispidulis vel muriculatis 1–3 cm. crassis, internodiis 1–3 dm. longis; foliis cordatis 2–4 (saepe ad 3) dm. longis 15–28 (saepe ca. 20) cm. latis, basi lobis semiovatis ca. 10 cm. latis et sinu oblongo saepe 4–5 cm. lato donatis, apice breviter acuminatis, supra lacte viridibus sub lente sparsissime albo-punctatis (punctis oblongis), subtus pallidioribus secus costam et nervos hispidulis vel muriculatis; costa folii applanata nervos parallelos primarios et secundarios et tertiarios gerente; nervis primariis applanatis evidentibus, basalibus utrinque 4–5 inferioribus 2–3 in costulas posticas latas 1–2 cm. longas basaliter confluentibus, costalibus utrinque 3 sub angulo ca. 45° patentibus; nervis secundariis 2–4 mm. longe separatis prominulis lineatis quam primariis evidenter gracilioribus quam tertiariis paullo sed distincte validioribus; petiolis hispidulis subteretibus saepe 3–4 dm. longis et 6–8 mm. crassis; spatha valde convoluta 15–18 cm. longa asymmetrica hinc conspicue ventricosa, intus rubiginosa, extus viridi laevi glabra; pedunculo in axilla solitario 5–12 cm. longo minute muriculato; spadice quam spatha paullo breviore sessili basi oblique affixa, parte feminea cylindrica ad anthesin ca. 17 mm. crassa basi valde obliqua (dorsaliter 2.5–3.5 cm. alta, ventraliter 3.5–5 cm. alta) maturitate 4 cm. crassa et ventraliter 5–7 cm. alta, parte masculina 7–8 cm. longa 10–12 mm. crassa; ovario ad anthesin 6–8 mm. longo 3–5-loculato (loculis biovulatis) infra medium 3–4 mm. crasso deinde sursum gradatim attenuato, apice 1.5–2 mm. diametro stigmatibus 3–5 juxtapositis sessilibus donato papyraceo-marginato, margine papyraceo 2–3 mm. lato saepe erecto; baccis aurantiacis 8 mm. altis ca. 6 mm. crassis; seminibus 4–5 mm. longis ca. 2 mm. crassis basi truncatis apice rotundis.

TYPE: *Johnston 967,* San Jose Island, along road about a half-mile east of Red Hill.

A coarse climber which is widely distributed and rather common on the island. It exposes its large cordate leaves in the shady interior of forests, on the top of the forest canopy, and on the tangle of vines draping isolated trees and on those curtaining forest margins, and occasionally even on the top of thickets. The plant is a hardy and highly adaptable one found in sur-

prisingly diverse situations. It is, for example, at home inside the high, dense, streamside forests where shade and moisture are always present, and, as well, even in such a contrasted environment as the deciduous forest on thin soil, where, climbing large trees of *Bombax,* it grows in parched soil and has no shade throughout the whole dry season. Once established the vine exposes its leaves, grows and reproduces in sun or shade and at times partially in both. Young individuals, however, seem to start only in shaded places. They spread their leaves and grow rapidly in half-light, such as that found inside of forests. The plant is a root climber. Its stems grow straight upward along a trunk, developing at the stem-nodes clusters of rootlets which grow into the bark and so affix the climber to its support. Stems of old plants are grayish, about 2.5 cm. thick, and in form very suggestive of garden hose. Tangled masses of them are frequently seen in crotches of trees where they have been caught and have continued to grow after becoming detached and slumped down from higher branches.

The large heart-shaped leaves of the plant are distinctive. They are usually 2.5–3 dm. long, 2–2.5 dm. broad, and light green in color, and have many slender, loosely spaced parallel veinlets of two different sizes prominent on the lower surface. The petioles as well as the stems bear scattered microscopic prickles or minute stiff hairs. On juvenile plants the stipular sheath is conspicuously decurrent on the petioles, forming papery-winged margins on the lower third or half of the latter. On most parts of the mature plant, however, the stipular sheaths are free from the petioles and fall away early, leaving characteristic ring-scars on the stem. They are decurrent on the petioles of mature plants only on those leaves subtending the axils from which spathes are produced, and on these only at the base.

The coarse asymmetric spathe is 15–18 cm. long and 5 cm. in diameter below the middle.. Its upper two-thirds is a coarse beak, but below this it gradually expands in thickness by dorsal swelling and then rounds off abruptly, with the lower fifth of the beak straight and decidedly oblique in lateral outline. The ventral side of the spathe is slightly outcurving when viewed laterally. The spathes are green outside and reddish inside. When maturing fruit they are sealed by very tightly appressed, overlapping margins and then contain quantities of a slimy liquid having an unusually nauseous odor. Great numbers of these sealed spathes were seen hanging from the vines during January and February.

The spadix is fertile right down to where it is broadly attached to the strongly oblique base of the spathe, and is consequently fertile lower down on the anterior than on the dorsal side. As a result of the broad, oblique, sessile attachment of the spadix its lower female portion has the appearance of being decurrent downward on the anterior inner base of the spathe. The only completely ripe fruit seen is some collected by Erlanson during the last of May. It is a mass of orange berries entirely freed from the spathe.

The species is known only from San Jose Island. Its precise relationships are in doubt. Two characters of the plant are very unusual if not unique in the genus; namely, the minute conic warts and the minute rigid hairs or prickles on its stems, pedicels and peduncles, and the papery margin surrounding its stigmas. In most respects the plant seems closely allied to *P. Hoffmannii* Schott, but that species differs in being glabrous and in having a thick 3-lobed stigma, as well as in numerous minor details. Unfortunately

the stigmatic structures were not studied in fresh condition. The flowering specimens collected by me have the maturing ovaries (these containing developing seeds) narrowed above the middle. There are 3–5 small stigmas crowning the ovary and surrounding them a slightly thickened rim on which is borne an erect or ascending papery margin 2–3 mm. wide. From dried material it is uncertain whether this papery margin makes a saucer-shaped or a cup-shaped structure when fresh. On ovaries long past anthesis the margin is erect and shrunken and appears somewhat tubular. This papery margin has not resulted from the activities of gall insects. It is developed in all my collections, on young and maturing ovaries, and significantly also on those maturing seeds. Engler & Krause, Pflanzenr. Heft **60: 127**, f. 43 (1913), have admitted *P. longistylum* Krause to the genus, despite its funnelform style. The present plant is no more aberrant and certainly can be accommodated in *Philodendron* also. It is named in honor of Dr. Carl O. Erlanson of the Bureau of Plant Industry, Washington, whose excellent specimens, collected during his long sojourn on San Jose in 1945, have been a continuous source of information during the preparation of this report on the flora of the island.

Johnston 12, 918, 960, 974; Erlanson 234, 402 in part.

Philodendron guatemalense Engler

A common root-climber found in all the forests of the island. In many places, especially so in the vicinity of streams, it is the most abundant leafy plant to be seen inside the forest. It may trail and form low growth on the shaded forest floor or climb trees, adhering to trunks by the numerous rootlets produced along its stems. Its leaves are frequently exposed on the viny curtains margining forests and on top of the forest canopy, but the greater proportion of them are displayed inside the forest in dense as well as partial shade. The elongate stems of the plant are slender but tough and mostly less than 1 cm. thick. The leaves have a petiole 9–20 cm. long which is unmargined for only 1–2 cm. below the leaf blade. The blade, 18–35 cm. long and 9–18 cm. wide, is rounded at the base and pointed at the end. The inflorescences, borne several in a cluster, are apparently produced most abundantly during May. The spathe, produced on a peduncle 2–3 cm. long, are 12–15 cm. in length and have a white blade about 2 cm. broad. In March and April 1945 I found a great many plants with large numbers of rootlets greatly elongated and terminated by ovoid or ellipsoidal insect galls. Similar galls are represented in the collections made by Andersson when he visited the island in April 1852. The galls, covered with numerous processes 1 mm. high, measure 8–12 mm. long and 6–8 mm. thick. Larvae were found in many of them. None of these galls were seen during my visit to San Jose during January and February 1946.

The species ranges from Guatemala to Panama and Colombia. *Johnston 541, 644, 807, 972; Erlanson 123; Andersson.*

Philodendron Harlowii, sp. nov. PLATE 14, FIG. 1

Planta altissime scandens glaberrima; caulibus ad 15 mm. crassis internodiis 1–2 dm. longis; foliis cordatis laevis 1.5–5 (saepe 2.5–3) dm. longis 10–35 (saepe 15–18) cm. latis, basi lobis rotundis saepe 6–7 cm. latis et sinu oblongo saepe 2–3 cm. lato donatis, apice subulato-acuminatis, supra laevis fusco-

viridibus sub lente abundantissime albo-punctatis (punctis rotundis), subtus pallidioribus juventate purpurascentibus; costa folii applanata lata albida nervos primarios et secundarios parallelos gerente; nervis primariis applanatis albidis, basalibus utrinque 3–4 inferioribus basi brevissime conjunctis, costalibus utrinque 3 sub angulo ca. 45° patentibus; nervis secundariis 0.5–1 mm. distantibus lineatis numerosissimis haud conspicuis, nervis tertiariis haud vel vix differentiatis; petiolis subteretibus vel supra plus minusve applanatis saepe 12–18 cm. longis 4–5 mm. crassis; spatha in axilla folii solitaria valde convoluta 15–19 cm. longa, infra medium 3–4 cm. crassa, supra medium 2–2.5 cm. crassa subcylindrica, basi subconica symmetrica in pedunculo 6–8 mm. crasso saepe 10 cm. longo contracta, extus viridi, intus rubiginosa; spadice 14–16 cm. longa quam spatha paullo breviore, basi 8–10 mm. longo crassi-stipitate ad basim versus spathae obliquae affixo; parte feminea spadicis cylindrica ad anthesin ca. 20–33 mm. crassa 5–6 cm. longa, parte masculina ca. 14 mm. crassa 8–10 mm. longa; ovario sub anthesi oblongo ca. 5 mm. longo ca. 2–3 mm. crasso 4–6-loculato, apice ca. 2 mm. diametro stigmatibus 4–6 juxtapositis sessilibus coronato; loculis ovulas numerosissimas pluriseriatas gerentibus; antheris oblongis 2 mm. altis ca. 0.8 mm. crassis ca. 1.5 mm. latis.

Type: *Johnston 1030,* San Jose Island, climbing trees in the streamside forest of Area 11B.

A viny species occasional in forests in all parts of the island and particularly in those along streams. It is usually found near a perennial source of water and in shaded or partially shaded places. It resembles *P. Erlansonii* in its climbing habit and has cordate leaves of similar form but differs in many other respects. It is entirely glabrous and dusky green in color and its main stems rarely exceed 1.5 cm. in diameter. The mature leaves have less conspicuous but more numerous lineate secondary veins than do the leaves of *P. Erlansonii* and are not only darker colored but also much smoother in appearance. They are usually about 2.5 dm. long and 1.5–1.7 dm. wide (only rarely becoming as much as 4.5 cm. long and 3.5 dm. broad). The juvenile plants of this species are very distinctive. They are to be seen frequently growing up trunks in streamside forests and attract attention because of their beautifully colored foliage. Their leaves, 1–1.5 dm. long and 0.5–0.7 dm. broad, are moderately cordate at the base, slenderly long-attenuate at the apex, and conspicuously mottled with purple, especially on the lower surfaces, and their petioles are free from the large, papery, frequently purplish stipular sheaths. The sheaths are usually caught between the stem bearing them and the tree trunk on which the stems adhere so closely, and so usually persist on the plant for long periods. On old stems, however, the stipular sheaths are promptly deciduous. The only leaves on adult plants having vaginate petioles are those in whose axils spathes are produced. The spathes, 15–18 cm. long and 3–4 cm. thick, are borne singly on peduncles 6–10 cm. long. They are only slightly asymmetric, being only obscurely oblique dorsally towards the base. They are greenish outside and reddish inside. The spadix, unlike that of *P. Erlansonii,* is elevated on a thick sterile stalk-like base about 1 cm. long and wide. The ovary, crowned by a broad, discoid stigmatic area, is 4–6- but usually only 5-celled and has each of its cells bearing numerous ovules along an axial placenta.

The species, a member of *Philodendron* § *Polyspermium,* is known only from San Jose Island, and apparently has no close relatives among the species reported from Central America and adjacent South America. It is associated

with the name of Mr. James R. Harlow, now living at Quinque, Virginia, who became interested in the plants of San Jose and botanized there while resident on the island during 1945. *Johnston 718, 919, 921, 1030; Erlanson 402, in part.*

BROMELIACEAE

Aechmea magdalenae Andre — Wild Pineapple

A plant forming huge colonies on wet banks along streams. It is present in most ravines near the coast, and in the interior of the island has a luxuriant development in Area 11D. Its great numbers of crowded clumps of huge elongate, thorny-margined leaves, springing from underground stems, create a dense and formidable growth that may dominate large areas along a stream. The ascending out-curving leaves, 2–3 m. long and 6–12 cm. wide, have vicious thorns on the margin. These sharp, claw-like thorns are all directed upward on the outer half of the leaf and downward on the lower half. No matter how the plant is approached they are ready to prick and claw savagely. The inflorescence springs from the center of the leaf-cluster. It consists of 2–3 spiny heads 1–2 dm. long, borne crowded at the summit of a stout peduncle 2–4 cm. thick and 4–6 dm. long. The fleshy heads are a mass of coarse, thick, spine-tipped bracts and are conspicuous because of their coloration. They are first bright red and for a time bear yellow flowers but become orange in age. At maturity they much resemble a pineapple, having a fruity odor and a pleasant acid flavor. The species ranges from Guatemala to Ecuador. (Fl. C. Z. p. 107, plate 11, sub *Ananas magdalenae*). *Johnston 334; Erlanson 214; Harlow 43.*

Bromelia Karatas L. — Piñuela

A characteristic plant of areas with poor thin soil. It is present on cliffs and barren islets along the coast and on ridges about the island, and is common in all deciduous forests. The plant forms low open clusters of laxly ascending, usually recurved leaves, and grows singly or in small open colonies. The leaves are 1–2.5 m. long, 2–3 cm. wide, and armed along the margin with forwardly directed sharp, claw-like thorns. The inconspicuous flowers are borne among woolly hairs at ground level at the center of the leaf cluster. In the same position, during October and November, the tightly packed fruit and much wool form a slightly convex mass 1–2 dm. in diameter. The fruit, usually about 4 cm. long and 15 mm. thick, is yellowish green and juicy. It has a refreshing, somewhat acid flavor suggestive of green apples. The species is widely distributed in tropical America. (Fl. C. Z. p. 107). *Johnston 235.*

Tillandsia fasciculata Sw.

An epiphyte occasional on large trees in streamside forest and on giant trees of *Bombax quinatum*. It is very common on trees in the Playa Grande mangrove swamp. The plant forms a tuft of grayish leaves 2–20 cm. long. No plants were seen in flower. Many, however, had persisting old inflorescences. These consisted of broad compressed spikes 2–3 cm. wide and 8–15 cm. long, borne crowded at the end of peduncles 1–2 dm. long. Good examples of the plant can be seen on the giant spiny *Bombax* growing beside the Loop about a quarter-mile north of Little Butch Trail. The species ranges

from Mexico and the West Indies into northern South America. (Fl. C. Z. p. 109). *Johnston 237; Erlanson 134.*

Vriesia sanguinolenta Cogn. & Marchal.

An epiphyte forming large clusters of broad, smooth, ascending, light green leaves. The plant is common and frequently conspicuous on the limbs of giant streamside trees. In the drier forests it is to be found, frequently associated with ant nests, on limbs just under the canopy, but is seldom noticed there. Growing in forests it is practically always 15 m. or more above the ground, but in mangrove swamps, where it is a frequent plant, it grows well only a meter or so above high-tide level. The leaves are smooth and rather thin and are light green in color, at times somewhat mottled with brown or purplish. They are 6–9 dm. long and as much as a decimeter wide. Their broad bases tightly clasp one another, forming a cup-like reservoir at the center of the cluster which remains full of water during the rainy season. The inflorescence, a meter tall, consists of a stout, erect axis that has a number of stiff branches which bear coarse bracts in whose axil the inconspicuous, greenish yellow flowers are produced. The species grows in Cuba, Jamaica, Costa Rica, Panama and Colombia. *Johnston 110, 274.*

Pitcairnia sp. ?

A single colony of what is apparently a large *Pitcairnia* was discovered in 1946 just east of the Navy Cove Road, about halfway between Navy Road and the landing at Navy Cove. The plants, not very numerous, were rooted in soil and perhaps all connected by underground rhizomes. They consisted of stalkless clumps of rather attractively colored, elongate leaves, and were to be seen here and there, protruding up through low thicket. All were sterile. Not even a remnant of an old inflorescence could be found.

The pliable ascending leaves became 1 m. long. Up to the middle they are strap-shaped, and 2.5–4 cm. broad, and then very gradually taper upward towards their sharp but friable tip. They are only 1.5–2 mm. thick and have many fine paralleling lineate veins, but absolutely no differentiated midrib. Their fibers are not tough. The thin margin is usually tightly and narrowly revolute. There are no thorns. The upper surface is reddish or brownish and at times mottled, and in age somewhat lustrous. The lower surface is gray, and examined under a microscope, proves to be coated with great numbers of very tiny chaff-like scales. This foliage agrees in almost every detail with that of *Pitcairnia albucaefolia* Schrad. That species, however, is known only from Martinique and St. Vincent in the West Indies and nothing closely resembling it is known from continental America. Our island plant is probably an undescribed species. It very likely has a large inflorescence of conspicuous red or orange flowers, which should be looked for during the latter half of the rainy season. *Johnston 1113.*

COMMELINACEAE

Commelina diffusa Burm. f.

In January 1945 this introduced weed was occasional in the lawn at Main Camp, but at the Goat Barn carpeted an area formerly covered by bales of hay. It is a juicy creeping herb with blue flowers borne in a spathe twice as long as broad which is rounded and open at the base. The plant is widely

distributed in the tropics. (Fl. C. Z. p. 110, sub *C. longicaulis*). *Johnston 1043, 1241.*

COMMELINA ELEGANS HBK.

An introduced weed growing in the lawns at Main Camp. Erlanson first found it in July 1945. It had become well established and common by January 1946. It is a juicy herb with its stems, mostly creeping, ascending only at the ends. The blue flowers are produced in spathes that are two-thirds as wide as long, bristly on the sides, and truncate and closed at the base. The plant is widely distributed in the warmer parts of America. (Fl. C. Z. p. 110). *Johnston 1040; Erlanson 555.*

Phaeosphaerion persicariaefolium (DC.) Clarke

A juicy herb with trailing stems, forming loose growths 1–1.5 dm. high and about a meter broad. In disturbed forest soils along Grabby Clutch Trail, Little Butch Trail, and the trail just west of the Bald Hill grassland, and nowhere common. The plant has the habit of a *Commelina*. The leaf sheaths are evidently brown hairy. The small flowers are pure white. The globose fruits, about 5 mm. in diameter, are white and have a crustaceous, fragile, pearly pericarp when they mature in January. The species is widely distributed in tropical America. (Fl. C. Z. p. 110, sub *Athyrocarpus persicariaefolius*). *Johnston 917, 1287.*

TRIPOGANDRA ELONGATA (Meyer) Woodson

A weedy introduced plant occasional in the lawns at Main Camp in January 1946. A juicy plant with leafy trailing stems. The small pink flowers are borne in globose clusters terminating slender peduncles. The species is widely distributed in tropical America. (Fl. C. Z. p. 111, sub *Tradescantia cumanensis*). *Johnston 999.*

TRIPOGANDRA FLORIBUNDA (H. & A.) Woodson

An introduced weed common in the lawns at Main Camp in January 1946. A juicy decumbent plant with narrow lanceolate leaves and loose terminal clusters of small white flowers. The species is widely distributed in tropical America. (Fl. C. Z. p. 111, sub *Leptorrhoeo filiformis*). *Johnston 894.*

SMILACACEAE

Smilax

This vine was seen only twice on the island, and in sterile condition both times. In November 1944 an individual was noted climbing the forest margin near the middle of the East Loop, and in February, 1946, another, just shedding its foliage, was encountered climbing high in dry forest near the west end of the Air Strip. The glabrous cordate leaves are 10–18 cm. long, 6–12 cm. broad, and palmately 5–9-ribbed. The petioles are 5–10 cm. long. The leafy stems are 2–5 mm. thick and armed with squat conic thorns, up to 3 mm. long, that are borne in pairs below many of the petioles. The main stems of the vine become at least 15 mm. thick. They are roughened by many narrow ridges and are belligerently armed with large numbers of conspicuous, flattened, hard, sharp thorns, 5–12 mm. long.

Without flowers or fruit the plant can not be identified. Dr. C. V. Morton, who has made a study of *Smilax*, examined a collection from the island. He

reports that it does not seem to represent any species known from North America and that, furthermore, it is unlike any species he knows from South America. *Johnston 1345.*

AMARYLLIDACEAE

Agave panamena Trel. CENTURY PLANT

Known only from some small barren, rocky islets in Bodega Bay off Long Beach and from the islets and large rocks forming the point of land at the south end of Playa Grande. The plant is restricted to very limited areas but is fairly common and conspicuous where present. The coastal sites where it is found are exposed, have very thin poor soil, become excessively dry during the rainless months, and support a very scanty perennial vegetation. The plant apparently spreads by elongate coarse rootstocks. Its leaf clusters are scattered. The very elongate, thickish, grayish green leaves are commonly 4–6 dm. long and 3–6 cm. broad above the middle. They are armed along the margin, at intervals of 8–15 mm., with sharp claw-like thorns 1–1.5 mm. long, and at the apex by a stout, dark brown, terminal spine 11–13 mm. long, which is weakly grooved below the middle on its upper side. The inflorescence is 2–2.5 m. tall with its upper two-fifths branched and fertile. Some individual plants from the colony at Long Beach, which had been transplanted in March 1945 and grown in pots at Camp, began to send up their inflorescences in mid-January 1946. Their flowering shoots reached 2 m. in height and were branching by mid-February before they were accidentally destroyed. Major Campbell collected a plant in full flower at the south end of Playa Grande on March 20, 1946. This had a great abundance of yellow flowers measuring about 5.5 cm. from the base of the inferior ovary to the tip of the corolla-lobes. The ovary was about 20 mm. long, the funnelform corolla-tube 15 mm. long and 10–14 mm. in greatest diameter, and the elongate ascending corolla-lobes about 20 mm. long and 4–6 mm. broad. The stamens were long exserted. I kept this species under observation during January, February and April and saw no wild plant sending up inflorescenses, nor any in flower nor any with even vestiges of fruit. Persisting, withered flowers were found on a few plants in early April 1945, but at no other time. Most of the plants seen by me had viviparous inflorescences which were producing numerous scattered small leaf-clusters, 5–10 cm. tall, which eventually became detached from the mother plant and were capable of developing into new plants when they fell in a place suitable for rooting and independent growth. The inflorescences producing these vegetative propagules all bore scars indicating that they had formerly borne flowers but had set absolutely no fruit. Several of the baby plants produced vegetatively by the inflorescence were found, still alive, in drift washed up on the strand at Long Beach. The species is known only from rocky islets about the Gulf of Panama. Possibly it has been spread by propagules carried by ocean currents. If the colonies of the species at San Jose have been so established, it probably means that they have each developed by vegetative propagation of a single individual. With the colonies widely separated and each probably made up of multiplications of a single plant, there is little or no opportunity for pollination between different plants and accordingly no production of fruit.

The species is known only from San Jose Island, from Urave Island, an islet just southeast of Tobaga, and from Vacamonte Point on the south coast of the Isthmus a few miles west of the Canal Zone. It is related to *Agave vivipara* L. and its allies, which range on the islands off the Venezuelan coast and along the adjacent mainland. (Fl. C. Z. p. 114). *Johnston 597; Erlanson 549; Campbell 1.*

Curculigo scorzoneraefolia (Lam.) Baker

A perennial herb with grasslike leaves bearing a small yellowish flower close to the ground. It grows in the grassland on Bald Hill, where Erlanson collected flowering specimens on July 26 and August 6, 1945. The species is widely distributed in tropical America. (Fl. C. Z. p. 114). *Erlanson 535, 576.*

Pancratium littorale Jacq. SPIDER LILY

Growing on sandy beaches, abundantly on those in Bodega Bay, and occasionally on and above sea cliffs. In a clearing in the forest, along Grabby Clutch Trail, two plants were seen growing on broken sandbags. The plant has a very coarse bulb 5–8 cm. thick, and produces a cluster of coarse leaves 3–6 dm. long. The leaves are 4–8 cm. broad above the middle and 2.5–4 cm. wide at the base. The white flowers have very narrow lobes ca. 12 cm. long and conspicuous stamens that are joined at the base in a funnel-shaped white corona 2–2.5 cm. deep. They are fragrant, short-lived, and produced in numbers at the end of a stout, erect peduncle. Erlanson found them in May.

The species is widely distributed in tropical America, especially on beaches and near the coast. Its seeds and bulbs are apparently both transported by the sea. The coarse bulbs are frequently found in beach drift. (Fl. C. Z. p. 115, sub *Hymenocallis americana*). *Erlanson 104.*

DIOSCOREACEAE

Dioscorea polygonoides H. & B.

A slender-stemmed, light green vine trailing over cleared ground or twining and forming netted growth on bushes. It was found only in disturbed places. It is very common on the cleared slopes back of the Guard House and in a few places along the road between the Guard House and the Supply Office. Elsewhere on the island limited numbers of the plant were seen near the Goat Barn, along the West Loop, along Grabby Clutch Trail, along the trails into Areas 11A and 8D, and along the East Road near the boundary between Areas 8A and 8B. The plant springs from a corm, develops its stems in the latter part of the rainy season, produces its fruit by the end of the year, and dies back to the ground by the end of February. The shallowly buried corm is of unusual form. It is simple or composed of several unequal, radiating lobes. Its parts are dorsiventrally compressed, 2–5 cm. long, 10–12 or rarely 15 mm. broad, and 4–6 mm. thick, and have the lower surface flattened and bearing numerous rootlets. The palmately veined, glabrous leaves are cordate, 4–12 cm. long and 3–9 cm. broad. The plants are unisexual. The minute yellow male flowers are borne in small clusters along a slender axis 10–25 cm. long. These slender spikelike inflorescences grow erect and are produced in great numbers. The fruit is dry, three-winged, 12–16 cm. long and 11–15 mm. broad, and is matured in conspicuous masses.

The species ranges from Mexico and the West Indies south into northern South America. (Fl. C. Z. p. 115, sub *D. macrostachya*). *Johnston 229, 854, 855, 1057, 1074.*

Dioscorea sapindoides Presl

A small vine twining on grass clumps in the grassland on Bald Hill and on low bushes in thin soil areas at East Harbor and along East Road near the boundary between Areas 8A and 8B. It is neither common nor conspicuous, having only a few sparingly branched stems, mostly much less than a meter long. The dark green sagittate leaves are 7–14 cm. long and 1.5–7.5 cm. broad. The small, hairy flowers are borne in small loose clusters scattered in a spicate inflorescence 7–15 cm. long. The plant was in flower in October 1944. In January 1946 the fruit was completely gone and the plants were dying back to the ground. The species is known only from Costa Rica and Panama. (Fl. C. Z. p. 115). *Johnston 41, 827A.*

IRIDACEAE

Cipura paludosa Aubl.

Growing among grass on rocky bluffs along the ocean near South Beach. It is a small bulbous plant with a white corolla 3–4 cm. in diameter. Erlanson found it in flower during July. The species is widely distributed in tropical America. (Fl. C. Z. p. 116). *Erlanson 409, 570.*

MUSACEAE

Heliconia latispatha Benth. PLATANILLO

A few colonies of this coarse herb are known along the east coast of San Jose just northwest of East Harbor. It grows along the stream draining into the first cove north from East Harbor and on the ledges at the end of the now abandoned Mortar Road a few hundred yards further north. A large colony, according to reports, is visible from off shore in a cove near the northeast corner of Area 8A. The plant grows 1–2.5 m. tall and has large leaves suggestive of those of the banana plant. The leaf-blade becomes 7–10 dm. long and 1.5–2 dm. broad. The erect inflorescence has curved, elongate, attenuate spreading bracts, 1–2.5 dm. long, which are first orange, then change to red, and finally become brown in age. The unusual ladder-like arrangement of the large, brightly colored bracts attracts attention. Inflorescences are developed during the closing four or five months of the year. The species ranges from Mexico to Panama, Colombia and Venezuela. (Fl. C. Z. p. 117, plate 13). *Johnston 1101; Erlanson 597.*

MUSA SAPIENTUM L. BANANA

When the Army arrived on San Jose, apparently the only banana plants on the island were those growing near the shore at Mango Beach. Along with the mango tree and a calabash tree growing near by, the banana plants at Mango Beach probably mark the site of a dwelling formerly located there. (Fl. C. Z. p. 116).

ZINGIBERACEAE

Costus Friedrichsenii Peters — CAÑAGRIA

A coarse, gray-green herbaceous plant, 15–30 dm. tall, which forms colonies in sunny open places where the soil is damp. It usually grows up through low thicket and is common in many places on the island. It is a conspicuous feature in the thickets along the Loop near its junction with Canyon Road. The coarse, erect stems are unbranched and bear numerous large oblanceolate, hairy, juicy leaves 3–5 dm. long and 8–10 dm. broad. The flowers, appearing during the first half of the wet season, are produced among the leaves at the summit of the stem and are 5–7 dm. long and white or pink with reddish markings. The fruit is matured in the cone-like head of bracts, 5–7 dm. thick and a decimeter or more long. The species ranges from Guatemala to Bolivia. (Fl. C. Z. p. 118, *sub C. villosissimus*). *Johnston 240; Erlanson 483.*

Costus villosissimus Jacq.

Growing on exposed cliffs and islets along the shore. The slender leafy stems, 9–12 dm. tall, are more or less spirally ascending and are bristly with tawny hairs. The green oblanceolate juicy leaves are 15–20 cm. long and 6–7 cm. broad. The corolla is bright yellow. The species is found in Central America and northwestern South America. *Erlanson 547; Harlow 7.*

Renealmia aromatica (Aubl.) Griseb.

Apparently an uncommon plant on the island. A few plants were found growing in disturbed ground in the forest along Little Butch Trail, along the trail west from Bald Hill grassland, and along the trail into Area 11A. In Area 11B it was frequent along the margins of the streamside forest. The plant produces one to several erect or ascending leafy stems, 10–18 dm. tall. The leaves are lanceolate to oblong-lanceolate, 2–3 dm. long and 4–5 cm. broad. The flowering stems are a meter or less tall and bear a narrow open panicle, 1–3 dm. long and 4–6 cm. thick. The corolla is yellow and the calyx and peduncles are red. Erlanson found the plant in flower at the end of July. The species is widely distributed in tropical America. (Fl. C. Z. p. 119, plate 16). *Johnston 1214; Erlanson 507.*

CANNACEAE

Canna lutea Miller

Less than a dozen plants grow in clearings along the road back of Englishman and Observer Beaches. When first seen in October 1944 some plants were old enough to flower. In January 1946 most all the plants were flowering and fruiting, but their total number had not increased. It is possible that the plant is a relic of a former period when the area they now occupy may have been cleared and under cultivation. It is difficult to believe that they could have been introduced after the Army arrived on the island. The plant grows about a meter tall. Its leaves are ovate or oblong-ovate, 15–45 cm. long and 10–18 cm. broad. The inconspicuous flowers are orange yellow and 5–6 cm. long. The lip is spotted. The two petaloid staminodes are notched at the apex. The species is widely distributed in tropical America. (Fl. C. Z. p. 119). *Johnston 257, 1046.*

MARANTACEAE

Calathea Allouia (Aubl.) Lindl.

Growing at the forest margin along the road to Englishman Beach and on shaded cliffs and near the stream below the pump at the Engineer Camp. The plant grows 8–18 dm. high. Its leaves are oblong-elliptic, 3–5 dm. long and 2–3 dm. broad, and are pale from a thin waxy coating beneath. The inflorescence is cone-like, 6–10 cm. long and 4–5 cm. thick, and composed of broad, rounded, spirally arranged bracts. The purplish flowers first appear about October. Fruiting is finished about the first of the year. The species ranges in Central America and northern South America. (Fl. C. Z. p. 120, sub *C. violacea*). *Johnston 208.*

Calathea lutea (Aubl.) Meyer.

About a half-dozen scattered plants were seen growing in sunny, disturbed soil in the forest along the jeep trails into Area 11D. The plant grows 5–10 dm. tall and usually has elliptic leaves 2–3 dm. long and 15–30 cm. broad which are green above but chalky white from a waxy coating beneath. The elongate inflorescence bears two ranks of broad, coarse, overlapping purplish bracts. The small flowers are yellow and first appear about November. The species is widely distributed in tropical America. (Fl. C. Z. p. 120). *Johnston 1163, 1330.*

Maranta arundinacea L. ARROWROOT

A slender perennial herb, 3–6 dm. tall, growing on exposed cliffs and on islets along the coast at East Harbor and on Hicaco Island. It spreads by slender rhizomes. The lanceolate leaves are 10–15 cm. long and 2–4 cm. broad. The sparsely and loosely branched inflorescence bears white flowers 1.5 cm. long. The species is widely distributed in tropical America. Its starchy rhizomes are the source of arrowroot flour. (Fl. C. Z. p. 121). *Johnston 925; Erlanson 437, 586.*

BURMANNIACEAE

Burmannia capitata (Walt.) Mart.

A single mature fruiting individual of this tiny annual herb was discovered mixed in with material of *Mitracarpus* that had been collected on the steep seaward slope of thin soil near Orangetree Beach on December 28, 1945. Its filiform simple stems, terminated by a small capitate cluster of tiny flowers, are 12 cm. tall. The species is widely distributed in the warmer parts of America but in Central America has been reported only from British Honduras and Panama. (Fl. C. Z. p. 121). *Johnston 952A.*

ORCHIDACEAE

(Identifications by C. Schweinfurth and L. O. Williams)

Aspasia principissa Reichenb. f.

An epiphyte collected in the forests near Orangetree Beach, in streamside forests in the eastern part of Area 4, and in forests at the south end of Little Butch Trail. Similar plants were observed in forests, particularly those along streams, in all parts of the island. It is one of the orchids commonly

found growing on the trunks of *Anacardium*. It has a strongly compressed oblong pseudobulb 10–15 cm. long and 1.5–3.5 cm. broad which springs from a basal cluster of leaves and is terminated by a pair of thin leaves 15–30 cm. long. The leaves have 8–10 moderately prominent primary ribs. The inflorescence consists of one to several flowers borne on a bracted peduncle 5–15 cm. long springing from the axils of the leaves at the base of the pseudobulb. The attractive part of the flower is the broad lip 1.5–2 cm. long, which is at first white or cream but becomes yellow in age. The species is known from Costa Rica and Panama. (Fl. C. Z. p. 147). *Johnston 136, 702, 1015, 1288; Erlanson 199.*

Bletia purpurea (Lam.) DC.

A terrestrial plant observed only on the sea cliffs at East Harbor, on the cliffs and barren islets along the coast on the point south of Playa Grande, and on barren islets along the shore of Hicaco Island. The plant has a depressed corm 2.5–4 cm. broad which is shallowly buried in the thin rocky soil. It develops leaves during the rainy season but is leafless during the dry season when it flowers. Many plants in a colony flower at the same time and make a handsome display, particularly attractive because of the dry, hot, and barren situation in which they are found. The flowers, observed at intervals between the end of December and the first of April, are about 2.5 cm. long, rose and purple, and borne in numbers in a loose raceme on a slender peduncle 4–8 dm. tall. The species ranges from Mexico and Florida south to Panama and Venezuela. (Fl. C. Z. p. 141, sub *Limodorum tuberosum*). *Johnston 567, 922.*

Brassavola nodosa (L.) Lindl. QUEEN OF THE NIGHT

Very common on exposed rocks of cliffs and islets along the coast. In the interior of the island it was observed only on some trees bordering on the grassland at Bald Hill and on some of the large deciduous trees on the eastern peninsula. It is a plant that appears to demand direct sunlight and one that can survive even on exposed rocks, where it is baked by the sun and is without water during the rainless season. It usually grows 10–25 cm. tall, forms a low shrubby caudex, and produces stiff, erect thick grayish green leaves 10–15 cm. long and 5–10 mm. broad. The inflorescence consists of a slender peduncle 5–10 cm. long which springs from the base of a leaf and is terminated by one to several flowers. The white flowers, borne plentifully during the wet season, are very fragrant after dark. They are composed of five narrow lobes and a conspicuous lip 2–3 cm. broad that is acuminate at the apex. The species ranges from Mexico and the West Indies south into northern South America. (Fl. C. Z. p. 141). *Johnston 121; Erlanson 438, 469; Harlow 20; Andersson.*

Catasetum viridiflavum Hook.

A coarse epiphyte observed only in the swamp at Main Beach. It has very swollen stems 15–20 cm. long and 4–6 cm. thick bearing a number of large, prominently ribbed, very coarse leaves 3–6 dm. long and 4–5 cm. wide. The large flowers, 4–6 cm. across, have a pouch-like lip and are hence somewhat suggestive of a Lady's Slipper. The species is known only from Panama. (Fl. C. Z. p. 142, plate 21). *Johnston 333.*

Cyrtopodium punctatum (L.) Lindl.

Plants of this species were obtained on San Jose by Mr. Walker and flowered in his garden in the Canal Zone in June 1946. Mr. Paul H. Allen, who examined and identified them, tells me that Mr. Walker, who did electrical work for the Engineers, reported that the species was common on certain rocks and cliffs along the coast of the island.

Almost certainly referable to this species is the very coarse orchid seen by me, only in sterile condition, at various places along the coast but most abundantly on the sheltered rocks near Main Beach. The clustered, coarse, thick stems, 1–3 dm. long, bear large many-ribbed leaves. They are leafless during the dry season and then notable for the pungently tipped leaf-bases with which they are armed. The stems and leaves, accordingly, much simulate those of *Catasetum*. The spotted yellow flowers, about 4 cm. broad, have a lip marked with red and are borne in a large spray. The species is widely distributed in tropical America, but, according to Mr. Allen, is not otherwise known from Panama.

Diacrium bilamellatum (Reichenb. f.) Hemsl.

A common epiphyte forming dense globular masses on exposed branches of trees growing along the coast. Its thick stems, 15–20 cm. long and 2–2.5 cm. thick, are usually hollow and inhabited by colonies of ants. The leathery leaves are 15–20 cm. long and 2–2.5 cm. broad. The flowers, 1–1.5 cm. broad, are pink and are borne on long-peduncled terminal racemes. Many of the flower buds never open and appear to be cleistogamous, since they mature fruits. The species is known from Central America and Venezuela. (Fl. C. Z. p. 137). *Johnston 703.*

Dichaea panamensis Lindl.

A small epiphyte frequent on trees, particularly on the trunks of *Anacardium* in streamside forests. It has several somewhat fleshy gray-green stems, usually 10–15 cm. long, bearing numerous two-ranked, spreading fleshy leaves 2–4 cm. long and 3–4 mm. broad. The small flowers, white or pinkish and spotted with purple, are about a centimeter long and borne singly along the leafy stems. The species is known only from Costa Rica and Panama. (Fl. C. Z. p. 149). *Johnston 400, 1013, 1216, 1219.*

Epidendrum imatophyllum Lindl.

An epiphyte widely distributed on the island. The plant always grows on earthen ant nests, either on exposed limbs or on tree tops where sunlight is available. It produces numerous stiff leafy stems 5–10 dm. long and 6–10 mm. thick. The leathery leaves are 10–15 cm. long and 1.5–2.5 cm. broad. The pink and purple flowers, about 15 mm. long, are borne in terminal clusters. These clusters, projecting out from the foliage of trees, give a splash of color on the sides of forests and attract attention from late February until early April. The species ranges from Mexico to northern South America. (Fl. C. Z. p. 137). *Johnston 595, 609, 614.*

Epidendrum Stamfordianum Batem.

A few plants of this epiphyte were seen in streamside forest in Area 11B, on forest trees along Little Butch Trail, and on trees along the stream back

of the Motor Pool. The stems, 2–3 dm. long and 15–20 cm. thick, are distinctly swollen above the middle and bear towards their upper end several stiff, thick, elliptic leaves 10–15 cm. long. The small yellowish flowers are borne in a loose panicle on a peduncle springing from the base of the plant. The species ranges from Mexico to northwestern South America. (Fl. C. Z. p. 137). *Johnston 1160.*

Habenaria pauciflora (Lindl.) Reichenb. f.

Collected by Erlanson during July and early August in the grassland at Bald Hill and on the grassy bluffs at East Harbor. It is a terrestrial herb with a slender, simple leafy stem 3–5 dm. tall bearing several cream-colored flowers 15–20 cm. broad. The flowers have a slender tubular nectary 4–5 cm. long. The species ranges from Mexico to Argentina. *Erlanson 426, 478, 585.*

Lockhartia pallida Reichenb. f.

A single colony of this epiphyte was found in the streamside forest in Area 11B. The plants flowered in January 1946. The stems are 4–7 cm. long and are clothed from top to bottom by two ranks of crowded, short, laterally compressed, strictly ascending leaves. The leafy stem, accordingly, has the appearance of a braided strap, 15–20 mm. broad. The very small yellow and white flowers are borne in a very loose, slender-stemmed, dichotomous inflorescence 5–10 cm. long and broad. The species ranges in Panama, Colombia, and Venezuela. (Fl. C. Z. p. 149). *Johnston 1217.*

Lycaste Campbellii C. Schweinfurth, sp. nov.

Herba epiphytica, pro genere parva, florum tempore sine foliis. Pseudobulbi caespitosi, complanato-ellipsoidei vel ovoidei, apice uni- vel bifoliati, vaginis distichis imbricatis foliiferis infra obtectis. Folia oblongo-obovata vel elliptica vel oblongo-elliptica, acuminata, basi longe angustata, membranacea, plicata. Inflorescentiae laterales, basales, uniflorae. Flos pro genere perparvus, viridis et aureus. Sepalum dorsale ovato-ellipticum, acutum, concavum. Sepala lateralia oblique oblongo-ovata, cum columnae pede mentum conicum formantia. Petala ovali-ovata, apice rotundato apiculata. Labellum in positu naturali erectum, columnae parallelum et leviter recurvum, super medium trilobatum; lobi laterales erecto-incurvi; lobus medius suborbiculari-ovatus, planus; discus medio unicallosus. Columna brevis, crassa, leviter arcuata, in pedem extensa.

Roots fibrous, numerous, finely pubescent to lanuginose. Pseudobulbs clustered, about 4.5 cm. or less high, surrounded by two or three pairs of distichous imbricating leaf-bearing sheaths which waste into fibers at flowering time. Leaves very variable in size, acuminate (apical portion commonly dried and imperfect in our specimens), long-narrowed and often subpetiolate below and more or less conduplicate in the dried specimen, with five to seven prominent nerves, up to 27.5 cm. long and 5.4 cm. wide. Inflorescence somewhat surpassing the pseudobulbs, several, suberect to spreading; peduncle filiform, up to 8 cm. long (commonly shorter), provided with several (five or less) loose tubulose sheaths which are relatively long and remote above and small and imbricating below. Flowers campanulate, with sepals green, petals yellowish green, and lip yellow. Dorsal sepals many-nerved, about 1.8 cm. long and 1 cm. wide when expanded. Lateral sepals acute, extending down the column-foot and forming a short conic mentum about 1.8 cm. long across the posterior part and 1.03 cm. wide in the middle. Petals about 1.55 cm. long and 1.1 cm. wide near the middle, with the upper margins minutely erose.

Lip erect, the sides of the lower portion incurved, adnate to the base of the column-foot, about 1.6 cm. long and 9.2 mm. wide below when expanded, ovate-elliptic in outline; lateral lobes erect and incurved with short ovate-subquadrate free apex having irregular margins; midlobe flat, rounded above with a recurved apicula; disc in the middle between the lateral lobes with a concave ovate-oblong apically rounded callus. Column about 7.1 mm. long at the back, extended into a stout ovate-triangular foot. Capsule obovoid-cylindric, 6-sulcate, up to 4.5 cm. long including the short pedicel.

TYPE: *Johnston 1371* (herb. Ames, no. *64779*), San Jose Island, epiphyte from streamside forest in Area 11B.

During January 1946 a colony of this species was discovered on a large fallen branch in the streamside forest in Area 11B. The very numerous plants were then all entirely leafless but were flowering abundantly. Specimens were made from some of the flowering individuals and others were taken to Camp and added to Major Campbell's collection of living orchids. These latter grew well and in September 1946 provided specimens in the leafy state needed for the identification of the species.

The plant in the leafless state is a compact mass of plump pseudobulbs. These latter are 3–4 cm. long, usually 2 cm. broad, elliptic in lateral outline, smooth and slightly lustrous on the sides, crowned by two hardened acute remnants of the leaf-bases, and closely invested at the base by other, disintegrating, very fibrous leaf bases. The yellow flowers, 15 mm. long, are borne terminally and solitary on slender bracted ascending stems 5–6 cm. long springing from the axils of the shredded leaf-bases which invest the pseudobulbs. In the leafy state of the plant the pseudobulbs bear usually two large leaves at their summit. Their body is partially hidden by the broad embracing bases of the leaves produced just below them. The leaves are 15–39 cm. long, tapered at both ends, rather thin, and rather prominently 5–6-ribbed beneath.

The species is known only from San Jose. According to Mr. Schweinfurth, who has studied and named the island plant, it is very unlike any of the known members of the genus *Lycaste*. The relatively small flowers are especially noteworthy, since conspicuous, often large and showy flowers otherwise prevail in the genus. Also notable in this species of *Lycaste* is its apparent lack of long hairs on the inner surfaces of the perianth. The species has been associated with the name of Major William Wesley Campbell, who grew the plant at San Jose and provided the specimens of its leafy state which have made its naming possible. *Johnston 1371; Campbell 12.*

Maxillaria Comaridii Reichenb. f.

This species grows on sheltered rocks and cliffs along the coast. Such as those near Main Beach, but is most common as an epiphyte in the forests. The stems are elongate, clothed by leaf bases, and bear leaves 1–4 dm. long and 6–15 mm. wide, as well as numerous lateral pseudobulbs that have an apical pair of leaves. The stems are frequently 5–10 dm. or more long and usually hang down in numbers from the branch or trunk to which they are attached. The white flowers are nearly 5 cm. long. The species is found in Costa Rica, Panama, and northern South America. (Fl. C. Z. p. 144, sub *Camaridium ochroleucum*). *Johnston 206; Harlow 58.*

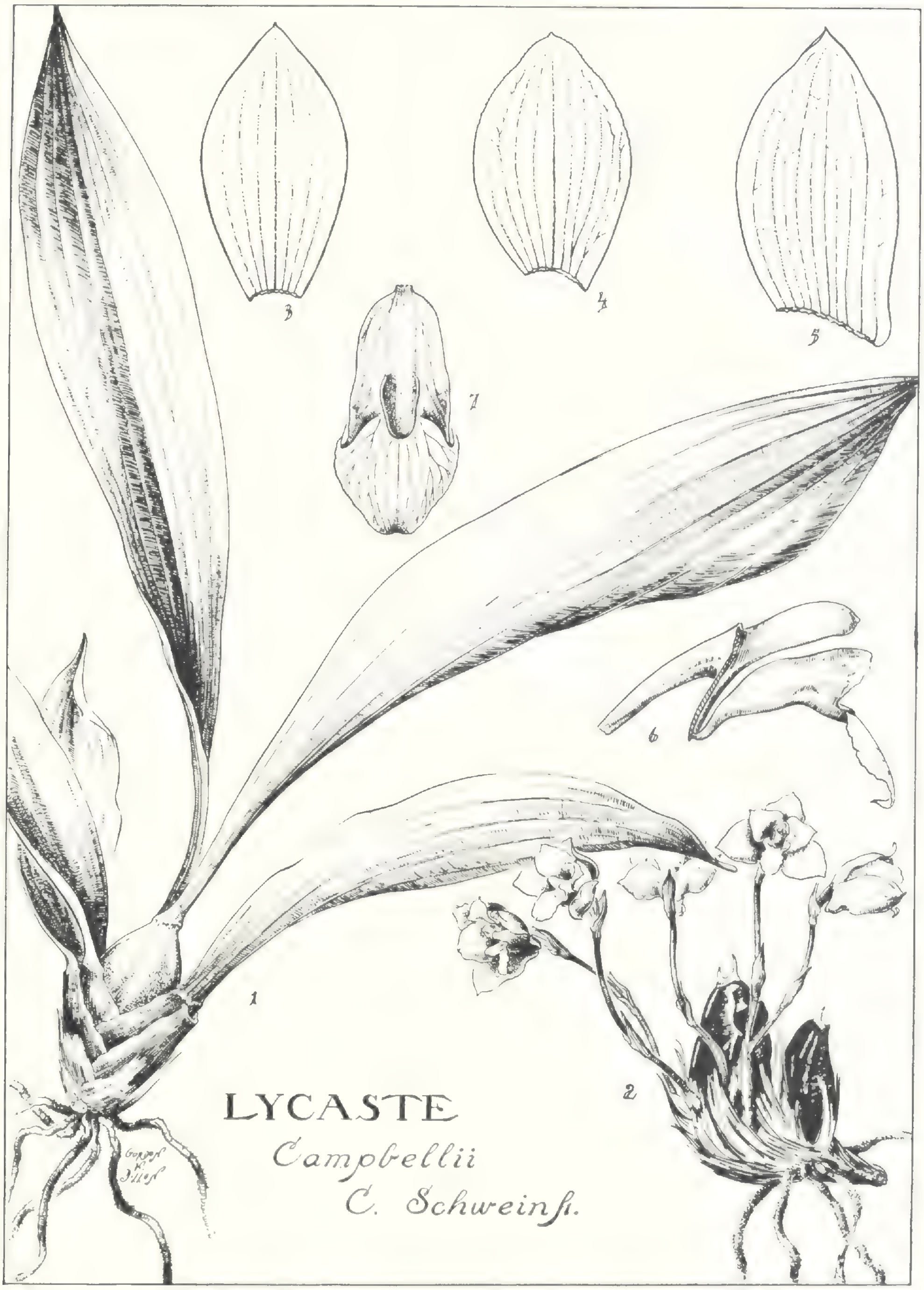


FIG. 1. Habit, plant with leaves. ×½. FIG. 2. Habit, plant with flowers. ×½. FIG. 3. Dorsal sepal. ×2. FIG. 4. Petal. ×2. FIG. 5. Lateral sepal. ×2. FIG. 6. Column and lip, natural position, from side. ×2. FIG. 7. Lip, from above. ×2.

Maxillaria crassifolia (Lindl.) Reichenb. f.

A frequent epiphyte in streamside forests, particularly on trunks of *Anacardium*. It has very much shortened stems, produces no conspicuous pseudobulbs, and is hardly more than a tuft of thickish leaves 1.5–4.5 dm. long and 1–2 cm. broad. The yellow flowers, 15 mm. long, are produced from the base of the leaves. The species ranges in Central America, the West Indies, and northern South America. (Fl. C. Z. p. 144). *Johnston 273, 1275A.*

Oncidium ebrachiatum A. & S.

Growing on the giant figs overhanging Canyon Road a few hundred yards from the Loop. The thick, nearly terete leaves, 3–5 dm. long and 5–10 mm. broad, are pendulous. There are no pseudobulbs. The flowers are yellow with the lip brown-spotted. They are borne in great numbers in an elongate panicle 15–20 cm. long and 5–10 cm. thick, elevated on a slender ascending peduncle. The plants were in full flower early in February 1946. They were identified by Paul H. Allen. The species is known only from Panama. *Johnston 1340.*

Oncidium panamensis Schlechter

A plant of this species was collected in late flowering condition by Erlanson on May 24, 1945, in "Area 2, north of Navy Cove." It is an epiphyte with large oblong laterally compressed pseudobulbs, about 15 cm. long and 3–4 cm. broad, which are prominently ribbed on the sides, and at the summit bear a pair of elongate leaves 5–10 dm. long and 2–2.5 dm. broad. The leaves have a conspicuous midrib, but their other ribbing is obscure. The small, spotted, yellow-brown flowers are produced in a loosely branched panicle a meter or more long. Sterile plants, apparently representing this species, were observed growing on *Bombax quinatum* near Canyon Road and at various places on the eastern peninsula. The species is known only from Panama. (Fl. C. Z. p. 148). *Erlanson 209.*

Pleurothallis Brighamii Wats.

A tiny epiphyte frequent on tree trunks in damp woods, and particularly so on *Anacardium* in streamside forests. The plant has an inconspicuous stem and usually forms small dense rounded clumps of leaves. The leaves are lanceolate, with a slender petiole 1–2 cm. long and a blade pointed at both ends, 3–5 cm. long and 6–9 mm. broad. The tiny orange flowers, 4 mm. long, are born terminally on thread-like peduncles 3–5 cm. long that spring from the base of the leaves. The species ranges from Guatemala to Panama. (Fl. C. Z. p. 135). *Johnston 135, 487.*

Pleurothallis sp. ?

Sterile plante apparently of this genus were found on a fallen *Anacardium* in streamside forest in Area 11B. The plant has an elongate, slender, creeping rhizome which produces at intervals small elliptic leaves at most 15 mm. long. *Johnston 1370.*

Scaphyglottis Behrii (Reichenb. f.) Benth. & Hook.

An epiphyte on trunks of forest trees. It was observed in Area 4C, Area 2A, Area 11B, and at the south end of Little Butch Trail. Plants were in full flower at the end of January 1946. The plant has numerous erect pale

fleshy stems 1–2 dm. tall and 3–7 mm. thick which may be pencil-like but are usually distinctly constricted at one or more points. They bear one or two pairs of leaves 1–2 cm. long and 3–6 mm. broad. The small clusters of white flowers, 3–4 mm. long, appear along the stem or at the base of the leaves. The species is known from Central America and Colombia. (Fl. C. Z. p. 136). *Johnston 1193, 1290.*

Scaphyglottis laevilabia Ames

Seen only on the trunks of trees in the forest at the south end of Little Butch Trail. The plant has several jointed green stems 10–15 cm. long. The internodes of the stem are 3–5 mm. thick near their base and then are gradually narrowed towards their upper end. The stems bear one to several pairs of leaves 3–6 cm. long and 3–5 mm. broad. The small white flowers, 4 mm. long, are borne in small clusters at the base of the leaves. The species is known only from Panama. (Fl. C. Z. p. 136). *Johnston 203, 1289.*

Sobralia fragrans Lindl.

A common epiphyte in streamside forests and especially on the trunks of *Anacardium*. It also grows on sheltered rocks and cliffs along the coast near Main Beach. The plants are commonly 15–25 cm. tall and, as seen growing, appear to be chiefly a cluster of leaves. The stems are distinctive. They are very strongly flattened, 2–3 mm. broad, and have acute edges. The leaves are pointed at both ends, 10–15 cm long, 2–3.5 cm. broad, and have five strong ribs. The flowers are moderately large, (white?), and terminal on leafy stems 15–25 cm. long. The species ranges from Guatemala to Colombia. (Fl. C. Z. p. 129). *Johnston 146, 1118.*

Sobralia panamensis Schlechter

Occasional as an epiphyte in the forests, especially near streams, and also on sheltered cliffs and rocks along the coast, as near Main Beach. The plant becomes very large and may have very numerous slender leafy stems 3–15 dm. long and 4–5 mm. thick. They are generally very untidy in appearance. The leaves, obtuse at the base and acute at the apex, are usually about 15 cm. long and 5 cm. broad and have 8–12 strong ribs. Their upper surface and especially their bases, which sheathe the stem, bear abundant minute black hairs. The flowers, pink and purple, are produced at the end of the stems and are the largest and most attractive blossoms produced by San Jose orchids. The species is known only from Panama. (Fl. C. Z. p. 129). *Johnston 212; Harlow 57.*

Spiranthes orchioides (Sw.) A. Rich.

Terrestrial herb found flowering on Bald Hill by Erlanson on May 22, 1945. The "creamy orange" flowers are 2.4–3 cm. long. The inflorescence, a loose raceme borne on a peduncle 3–4 dm. long, springs from the ground while the plant is leafless. The species is widely distributed in tropical America. (Fl. C. Z. p. 132, sub *Stenorrhynchus orchioides*). *Erlanson 228.*

Trichopilia maculata Reichenb. f.

An epiphyte occasional on mossy trunks in streamside forests. It has very strongly flattened, oblong pseudobulbs, usually 3.5–4 cm. long and 15 mm. broad, that grow flattened against the tree trunks and bear at their apex a

single leaf 8–12 cm. long and 1.5–3 cm. broad. The yellow and white flowers, 3.5 cm. long, are terminal on short stems arising from the base of the pseudobulb. The species ranges from Guatemala to Panama. (Fl. C. Z. p. 147). *Johnston 148, 1276.*

Xylobium foveatum (Lindl.) Nichols

An epiphyte found growing on *Anacardium* in streamside forests near the Cross Roads, in Area 4 along the trail to Playa Grande, and in Area 11B. Its pseudobulbs, 5–7 cm. long, are only very obscurely compressed. They are 2–2.5 cm. thick near the base and then taper towards the apex, on which two coarse, long-petiolate leaves are borne. The petioles are 4–12 cm. long. The leaf blades, acute at both ends, have three strong ribs and are 15–30 cm. long and 3–6 cm. broad. The white flowers, 15 mm. long, are borne in an open raceme on a shoot arising from the base of the pseudobulbs. The species is found from Mexico to Peru. (Fl. C. Z. p. 142, sub *X. stachyobiorum*). *Johnston 1017, 1117.*

PIPERACEAE

(Identifications by T. G. Yuncker)

Peperomia hymenodes Trel.

An epiphytic herb frequent on the giant trunks and branches of *Anacardium* in streamside forests. It is seldom found growing at a height less than 5 m. above the ground and is not a conspicuous plant. Its stem consists of a fleshy elongate rhizome 3–4 mm. thick, that creeps over the bark and is tightly affixed to it by many clusters of rootlets. The foliage, clustered at the growing end of the rhizome, is developed only during the rainy season. The leaves are light green, thin but somewhat fleshy, palmately ribbed, ovate or elliptic. They are 2–10 cm. long and 1.5–7 cm. broad, and are borne on slender petioles up to 1 dm. long. Fruiting is completed and all foliage is shed during January. The rhizomes are coated with minute scales and appear light gray or even silvery when dry and so allow the plant to be recognized when even in the leafless resting condition.

The names of the *Piperaceae* here accepted were supplied by Professor T. G. Yuncker. He identified only those collections which I myself made on the island. For the assigning of the Erlanson collections to the various species I alone am responsible. *Johnston 443, 1037, 1138.*

Peperomia pellucida (L.) HBK.

An erect, much branched, very juicy herb 1–5 dm. tall, which forms colonies on rocks, islets, and exposed cliffs along the shore, and in open areas of thin soil in the vicinity of the coast. Its very numerous ovate or cordate leaves are 1–2.5 cm. long and nearly as wide. The plant was frequent and even locally abundant at many places during the month of October. Apparently, however, it dries up soon after the advent of the dry season, since I found no individuals surviving at the end of December. The species is widely distributed in tropical America. (Fl. C. Z. p. 156). *Johnston 126, 178.*

Piper acutissimum Trel.

A loosely branched bush, 1.5–2.5 m. tall, growing in streamside forest in Areas 7C and 11B. The branches and twigs are slender and rather conspicu-

ously thickened and knobby at the nodes. The nearly symmetric lanceolate leaves, 10–15 cm. long and 2.5–4 cm. broad, are slenderly long attenuate at the apex. They are light green, firm but relatively thin, and completely glabrous. The species is Panamanian. (Fl. C. Z. p. 153). *Johnston 1215, 1327.*

Piper aequale Vahl

A loosely branched bush, 1–3 m. tall, which very much resembles the preceding species and, superficially, differs from it only in having larger leaves. The leaves usually measure 15–20 cm. long and 4.5–6 cm. broad. The plant was collected in shady streamside forest near the Navy Station and near Camp, and in Pump Ravine and in the canyon north of Red Hill. It represents what was described as *P. pseudo-variabile* Trel. var. *collium* Trel., which Dr. Yuncker thinks is best included in the older *P. aequale* Vahl. (Fl. C. Z. p. 154, sub *pseudo-variabile*). *Johnston 134, 263, 717; Erlanson 146, 354.*

Piper breve C. DC.

A shrub 2–2.5 m. tall, unique among the island pipers in the abundance of fine pubescence on its twigs and foliage. The plant was seen only in the streamside forest in the canyon north of Red Hill, in the forest on the outer headland of Punta del Cabo, and under *Hibiscus tiliaceus* on a bank near the beach at the mouth of the stream draining Area 11B. Erlanson collected it in a very shady ravine in Area 11D. The leaves are 10–20 cm. long, and 4–8 cm. broad just below the middle. They are dark green and somewhat scabrous on the upper surface, while beneath they are grayish and distinctly pubescent, especially along the veins and midrib. At the base they are abruptly contracted and distinctly oblique with the blade commonly attached to the midrib about 5 mm. (or rarely as much as 8 mm.) lower down on one side than on the other.

Dr. Yuncker writes that the material agrees reasonably well with the var. *pallidineurum* Trel., the chief differences being in leaf size, which is not important. (Fl. C. Z. p. 155). *Johnston 687, 1019, 1404; Erlanson 376.*

Piper falcifolium Trel.

A shrub or small tree, 3–6 m. tall, growing in the shady forest back of the Navy Station, on the north slope of Red Hill, and in Area 11B, and also in low thicket along the road between Areas 4 and 5. The glabrous, asymmetric leaves, 14–24 cm. long and 3.5–9.5 cm. broad at the middle, are dull dark green above and pale and opaque beneath. Their very oblique base is especially notable, the blade being affixed to the midrib 5–15 mm. lower down on one side than on the other.

Dr. Yuncker informs me that the species is very closely related to *P. arboreum* Aubl. and may not be separable from it. *Johnston 424, 594, 656, 1373.*

Piper marginatum Jacq.

A weak shrub, with main stems becoming as much as 2 cm. thick, which was observed in second-growth thickets south of Pump Ravine and about the margins of the forest in Camp Valley. It is readily recognized because of its thin palmately many-ribbed, acuminate-tipped, cordate leaves, 1–2.5 dm. long and 8–20 cm. broad, which are borne on petioles that are 3–6 cm. long and winged on the margin at least below the middle. The herbage is more or

less aromatic. The quantity and quality of its odor is surprisingly inconstant. Frequently it is rather nondescript, but at times it is decidedly that of licorice and occasionally very strongly so. A colony readily observed is to be found along the road in open forest near the road junction back of Englishman Beach. (Fl. C. Z. p. 153, sub *P. san-joseanum*). *Johnston 259, 319, 472, 1376.*

Piper subtrinerve Trel.

A shrub, 1.5–3 m. tall, growing in sunny thicket along Canyon Road. The practically symmetric lanceolate leaves, 10–20 cm. long and 3–6 cm. broad, are entirely glabrous. The upper surface of the leaf is glossy, and below the middle, at least, has the midrib evidently impressed. (Fl. C. Z. p. 154). *Johnston 81.*

Piper tapianum Trel.

A plant closely resembling *P. subtrinerve* in appearance and habits and apparently distinguishable from it only by the presence of minute hairs along the midrib and veins of its lower leaf surfaces. It grows 3–6 m. tall and is found in sunny thickets along Canyon Road, near Bald Hill, and along the trail to E. M. Beach. (Fl. C. Z. p. 154). *Johnston 754, 1360; Erlanson 176, 227.*

Piper sp.

A shrub, 12 dm. tall, collected by Erlanson (no. *144*) on a "moist shaded stream bank near Main Beach." It much resembles *P. tapianum* but differs in the abundance of short soft hairs evident on its younger stems and on the midrib and veins of its lower leaf surfaces. The following key may serve to distinguish it from the other island species of this very puzzling and complicated genus.

Leaves cordate, palmately many-ribbed. ..... *P. marginatum*
Leaves elongate, pinnately veined.
  Leaf blade very conspicuously asymmetric at base.
    Leaves glabrous, smooth; nodes of stem very conspicuously thickened. ..... *P. falcifolium.*
    Leaves abundantly short-hairy and somewhat scabrous; nodes not conspicuously thickened. ..... *P. breve.*
  Leaf blade nearly symmetric at base.
    Upper surface of leaf dull, bearing an evident, slender, slightly prominent midrib.
      Leaves mostly 2.5–3.5 cm. broad, 10–15 cm. long. ..... *P. acutissimum.*
      Leaves mostly 4.5–5.5 cm. broad, 15–20 cm. long. ..... *P. aequale.*
    Upper surface of leaf glossy, at least below middle distinctly grooved down its midline, its midrib obscure.
      Leaves completely glabrous. ..... *P. subtrinerve.*
      Leaves hairy, at least along midrib beneath.
        Stem, petiole, and lower leaf surface evidently short-hairy ..... *P.* sp.
        Stems glabrous; petiole and lower leaf surface with some hairs. ..... *P. tapianum.*

ULMACEAE

Trema canescens (HBK.) Blume

A tree growing with *Trema micrantha* and similar to it in habit, but much less common. It was first distinguished from *T. micrantha* in January 1946, and then promptly detected in the company of that species in second growth

thickets in all parts of the island. Since the trees are the same size as those of its companion species and have individually preëmpted as much space in the second growth, it seems obvious that they are the same age and that seedlings of the two species appeared simultaneously on the clearings of the island. I found no trees of this species away from roads and clearings made by the Army nor any old trees that might antedate the advent of the Army on the island, though I suspect that exploration of the cliffs would reveal some.

Once its characters are recognized, the tree is easily distinguished from its more common companion *T. micrantha*, even from a rapidly moving passing car. Its broader leaves are ovate-lanceolate, pale-hairy beneath, obliquely cordate at the base, and 8–15 cm. long and 3–7.5 cm. wide. The stiffer twigs give *T. canescens* a form of growth perceptibly different from *T. micrantha*. The terminal shoot on the main axis of the tree is erect, giving its somewhat broader crown a pointed top, thus distinguishing it from *T. micrantha* in which the more limber terminal shoot decurves and the slightly narrower crown is rounded on top. A branch of *T. canescens* has its lateral twigs divaricate, as also the leaves upon the latter. In *T. micrantha* the twigs usually slope downward on either side of the branch and so also do the leaves on the twigs. The color of the bark in the two species differs, that in *T. canescens* being a lighter shade of brown. The tree of *T. canescens* with its pallid, larger, more spreading leaves and stiffer, regular branching, is accordingly a paler, more symmetrical and seemingly somewhat more robust tree than its relative. Wherever the two species grew on the island they could be instantly distinguished. Absolutely no evidence of hybridization was seen. When *T. canescens* was first recognized in January 1946, it was just beginning to flower, possibly for the first time, whereas *T. micrantha*, growing with it, had been in flower and fruit at least a month and perhaps much longer.

The species is found in Florida and from southern Mexico to Panama. Botanists have generally not distinguished it from *T. micrantha*, or have at most treated it as only a phase of that species. It may behave differently elsewhere, but on San Jose its behavior is that of a species distinct from *T. micrantha*. *Johnston 1082, 1192.*

Trema micrantha (L.) Blume

A fast-growing weed-tree that has become very common in disturbed soils, especially in abandoned clearings and along roads in areas that formerly were covered with thicket or open forest. Before the Army with its bulldozers arrived on San Jose the plant was probably uncommon and represented only by very scattered trees on cliffs and rocky crests, such as those observed in 1944 along Canyon Road and near the Hospital, and in 1946 about the rocky summit of Hicaco Island. These old trees grow 8–11 m. tall. In the spring of 1945 seedling trees had become conspicuous, generally 2–3 m. tall, and were beginning to make second growth thickets along roads and clearings. The following year these seedlings had become 6 m. in height, and most of them were flowering and fruiting abundantly. Their trunks, breast high, had become 5–12 cm. thick. In the company of *Cecropia* and *Ochroma* they had become a familiar feature along many of the roads on the island. The lanceolate leaves, 8–15 cm. long and 2–4 cm. broad, are obliquely rounded at the base. The small coral-red fruit is globose, 2–3 mm. in diameter, and

borne in small branched cymes along the leafy branches. They are eaten by birds, which may aid in the dissemination of the plant.

The species is found throughout tropical America, where it is well known for its ability to appear promptly and grow rapidly in sunny disturbed soils, particularly in abandoned or new, unused clearings. The seeds of the plant appear to be widely distributed and to retain their vitality for long periods, buried in tropical soils. Disinterred in the clearing of land, they allow the plant to appear suddenly in abundance where for years previous, as on San Jose, the species may have been rare. (Fl. C. Z. p. 157). *Johnston 269; Erlanson 37, 257; Harlow 15.*

MORACEAE

Cecropia arachnoidea Pittier GUARUMO

A common and characteristic tree of thicket areas in all parts of the island and one that appeared promptly and in great abundance in disturbed soil along roads and in clearings. It is a tree of distinctive appearance and is recognizable by the most casual observer. It has a slender pallid trunk, a few loose branches, and an open crown of large, long-stalked, radiately lobed leaves which are green above and white beneath. Though other kinds of trees growing in the thickets are much encumbered with vines and usually have their trunks hidden in a skirt-like curtain of them, the trees of *Cecropia* are usually entirely free from viny growth. The tree, as it is commonly seen standing in thickets, is 7–12 meters high. Some very old trees occasionally found in open forests may attain at least 20 m. in height. The trunk, ringed by old, stipular scars, becomes 15–30 cm. thick and is supported at the base by a cluster of stilt roots 5–10 dm. long. Its sap is watery. The peltate leaf-blades usually have nine radiating lobes and are commonly 3–4 dm. broad. During the wet season the tree has its numerous large, contrastedly colored leaves clean and well spread, and presents a rather gay appearance. By the end of February most of the large old leaves are shed. The branches bear only some half-grown, partially expanded leaves at their ends and a few persisting, rather dejected old leaves. The tree takes on a sickly, unkempt appearance that persists during the remainder of the dry season. The trees are either male or female. The minute flowers are borne in dense elongate spikes. The grayish female spikes, 5–8 cm. long, nearly 1 cm. thick, are borne sessile, four or rarely five, in a stalked cluster. The yellow male spikes are 3–5 cm. long, 3 mm. thick, and have peduncles 3–4 mm. long. They are borne 20–25 in stalked, crowded clusters. The principal period for flowering on the island appears to be at the close of the wet season in November and early December.

The tree grows rapidly. In November 1945 individuals growing in soils cleared by bulldozers before mid-April that year had reached 1.5–2.5 m. in height. A year later such trees were approaching 7 m. in height and had trunks as much as 10–12 cm. thick and were beginning to branch. Although the tree springs up promptly and abundantly on bulldozed clearings of the island, giving evidence that its seeds are common and widely distributed in the soil, young trees are extremely rare in undisturbed places. Mature trees are a familiar sight in the thickets of San Jose, but, though I looked in undisturbed thicket for seedlings of *Cecropia*, I found none nor any trees that might be relatively young trees of this species.

The trunk, branches, and leaf-bearing twigs of the plant are partially hollow and are usually inhabited by colonies of ants. I found no old trees without ants. However, the sudden increase in available homes for ants occasioned by the springing up of *Cecropias* in clearings on San Jose was too rapid for the ant population on the island. Dense stands of *Cecropia* two years old along some stretches of road had only scattered trees occupied by ants. In areas where only scattering growth of *Cecropia* has sprung up, the majority of the young trees were inhabited.

The island species is apparently known only from Panama, but is distinguished with difficulty from plants ranging along the Pacific Coast from Mexico to Costa Rica, and perhaps is not worthy of separation from them. (Fl. C. Z. p. 159). *Johnston 78, 154, 155, 471, 914; Harlow 87, 233.*

Coussapoa panamensis Pittier

A rather common tree in the forests, particularly those along streams. Occasional individuals of this tree may develop from seeds germinating on the ground. Without support these may grow up to 15 m. tall. Usually however, the seeds germinate on branches or in crotches of forest trees, and the plant starts life as an epiphyte. Roots are soon sent down to the earth along the trunk of the host. In many cases these roots increase in size and number and eventually encase and strangle the trunk of the host. After the death of the latter they are strong and rigid enough to act as trunk for the strangler, which is now a high, self-supporting forest tree. In other cases, particularly those in which the host is very large, the latter may be handicapped but not killed by the *Coussapoa* and the branches of the two grow intermingled. Many of the large trees of *Anacardium, Luehea* and *Ficus* on the island are victimized by this plant, but are rarely mastered by it. Its leaves are distinctive. They are ovate, usually 10–17 cm. long, green above and white beneath, with numerous strong, straight, nearly parallel unbranched veins. They are frequently found on the forest floor and are very conspicuous there during the dry season. The fruit consists of a ball-like cluster of corky capsules 2.5–4 cm. in diameter, borne on a slender stalk 3–7 cm. long. They are frequently seen, sometimes in great abundance, on the forest floor beneath the tree. I found them most commonly at the end of the wet season in October and November. The species ranges from Guatamala to Panama. (Fl. C. Z. p. 162). *Johnston 580, 606, 608, 652, 578; Erlanson 240.*

Ficus Bullenei, sp. nov. PLATE 15, FIG. 1.

Arbor 3–21 m. alta; ramulis cinnamomeis cum pilis erectis ascendentibus rectis 1–2 mm. longis multiseptatis saepe velutinis; stipulis 1–2 cm. longis pilis brunneis vestitis; lamina folii saepe obovata sed non rariter oblonga vel elliptica 10–20 cm. longa 6–11 cm. lata saepissime supra medium latiore firmiter chartacea, apice obtusa vel subrotundata vel brevissime latiusculeque acuminata, margine non rariter anguste subrevoluta, supra saturate viridi costa et venis majoribus hirtellis plus minusve impressis nullo modo prominentibus donata, subtus valde pallidiore costa et venis et venulis valde prominentibus pilis brunneis vestitis ornata; venis primariis utroque latere costae 6–8 sub angulo 60°–70° abeuntibus; petiolis 1–3 cm. longis; receptaculis geminatis pilis griseis abundantibus vestitis subvelutinis 1–4 mm. longe inconspicueque pedunculatis globoso-turbinatis vel oblato-globosis in vivo

1–2 cm. diametro (in sicco 9–14 mm. diametro) apice in collum anomalum elevatum 1–2.5 mm. altum sursum dialatum 2–3 mm. diametro abrupte contractis; ostiolo occulto in fundo colli sito; involucro bilobato 4–5 mm. lato pilis brunneis adpressis vestito, lobis integris vel lobulatis.

TYPE: *Johnston 389*, San Jose Island, near Main Camp, small tree in high thicket.

A small bushy tree, 3–8 m. tall, growing in thickets and along forest margins, or a forest tree up to 20 m. tall. It grows in all parts of the island, perhaps most frequently in the eastern parts, but even there scattered and never common. A few young plants were noted growing as epiphytes in high thicket and one was seen on a large forest tree, but all old plants observed were self-supporting and gave no indication of a possible epiphytic origin or an early strangling habit. Large individuals in the forests have a trunk 3–6 dm. thick which may have small thick buttresses. The bark is grayish or somewhat russet. The roots are yellow and very conspicuous in soil newly disturbed by bulldozers. The twigs, foliage and figs are velvety with abundant reddish brown hairs.

A very fine specimen of the tree grows near the center of Area 11D, at the end of the jeep trail entering the area from Bald Hill Road. It grows on a terrace above the stream and can be readily compared with an equally fine specimen of *F. Popenoei* on the same terrace about 50 yards to the northwest. Another good example grows on the west side of the Loop about 300 yards from East Road. A small tree grows on the cliffs below the Lookout at the mouth of Bodega Bay and another one is found west of the Officers' Bungalows along the road to the Communications Office.

The tree resembles that of *F. Popenoei* in general appearance, but differs conspicuously in its figs. These are 1–2 cm. broad, depressed globose, distinctly broader than long, and at the apex provided with a conspicuous collar surrounding the ostiole. They are matured at the end of the wet season. I found them abundant in November 1944. The hairy, usually obovate leaves, 10–20 cm. long and 6–11 cm. broad, resemble those of *F. Popenoei*, but average larger and are more reddish in color with the hairs of their velvety indument more abundant and coarser. Furthermore, the veins are coarser, much more branched, and more prominent beneath. The upper surface of the leaf is roughened by sunken veins in *F. Bullenei*, but not so in *F. Popenoei*.

The species is known only from San Jose and from a collection made near Corozal, Canal Zone, that has been improperly identified as *F. velutina*. The precise relationship of the species is obscure. Its strongly oblate, hairy figs, with a high apical collar, readily distinguish it from all other members of the genus described from America. The high collar that surrounds the ostiole is very unusual and is apparently shared only with *F. trachelosyce* Dugand, a very different species from Colombia. It is with pleasure that I associate with this tree the name of Brigadier General E. F. Bullene, USA, who was Commanding General of the San Jose Project from its inception until June 1945.

Ficus Campbellii, sp. nov. PLATE 15, FIG. 2

Arbor 15–25 m. alta; ramulis crassiusculis glabris dilute cinnamomeis vel pallide fuscis; stipulis 1.5–2.7 cm. (saepe ca. 2 cm.) longis deciduis lanceolato-acuminatis glabris vel juventate pilis adpressis sparsis fugaceis donatis; lamina

folii coriacea glabra elliptica ad elliptico-oblongo vel late elliptica 12–24 cm. longa (5–) 6–12 cm. lata medium versus vel rarissime paulo infra medium latiore, basi obtusa vel subrotundata, apice rotundata vel obtusa, subtus pallidiore costis et venis prominulis donata basim versus 3-costata vel obscure 5-costata; venis primariis utroque latere costae 9–13 sub angulo 65°–80° abeuntibus marginem versus vix conspicue confluentibus; petiolis 2–5 cm. longis atrorubescentibus 2–3 mm. crassis; receptaculis geminatis 5–10 mm. longe pedunculatis depresse globosis 1.7–2.5 cm. altis 2–3.3 cm. diametro glabris saepe sparse purpureo-maculatis apicem versus annulo 10–13 mm. diametro ca. 1 mm. altis et crassis donatis; involucro bilobato 12–15 mm. lato, lobis ovatis 5–7 mm. latis integris plus minusve reflexis; ostiolo prominenti cum annulo ca. 4 mm. diametro obscure deltoideo ca. 0.7 mm. alto circumdato.

TYPE: *Johnston 721*, San Jose Island, Playa Grande, a large tree on beach backed by mangrove swamp.

A large, buttressed tree, 15–25 m. tall, widely distributed on the island but scattered and uncommon. It grows in streamside forests and, surprisingly, also in thickets on the slopes of rocky ridges. Among the island fig trees it is surpassed in size only by *F. Dugandii*. Its plank buttresses may be moderate to large, but they seldom extend up the trunk more than 1.5–2.5 m. The smooth gray cylindrical trunk frequently reaches a meter in thickness. A fine, widely spreading specimen grows on the low cliff beyond the stream mouth at Main Beach. As a tall giant tree, 20–25 m. high, it may be seen at the east margin of the yard of the Motor Pool, and again along the Cut Off at the north side of that road just east of the stream. A picturesque but perhaps moribund specimen stands isolated at the foot of the slope back of the E. M. Barracks.

The leaves are somewhat leathery, elliptic or oblong-elliptic in form, 12–24 cm. long and 6–12 cm. broad, rounded or obtuse at the base and apex, and borne on a coarse petiole 2–5 cm. long. It has 9–13 pairs of veins. The foliage is renewed during February and March. Before the leaves fall they turn yellow or crimson, and for a couple of weeks the tree stands out in the forest because of its unusual and attractive coloration. The terminal bud is 15–27 mm. long. The figs, depressed globose in form, are 20–33 mm. in diameter and are borne in pairs on coarse peduncles 5–10 mm. long. They are distinguished from the figs of other species on the island by their large size and by having the small but prominent ostiole at the center of a flattened apical area bounded by a circular ridge about 1 cm. in diameter. The trees seem to fruit sporadically. I found some fruiting trees on each of my three visits to the island, which covered the months from September through May.

The species is a well-marked one known only from San Jose. The peculiar ridge that encircles the apex of the fig is apparently unique among American species of the genus. With this tree I associate the name of Major William W. Campbell, Technical Director of the San Jose Project during my third visit to the island.

Ficus crassiuscula Warb.

An attractive, large, handsome tree 15–25 m. tall, with widely spreading crown and pallid trunk and branches. A number of fine specimens of the tree grow in Camp Valley, one overspreading the road in front of the Supply Office and another dominating the forest at the southeast corner of the yard at the Motor Pool. Elsewhere on the island it was found only along Canyon

Road, where, several hundred yards from the Loop, a number of magnificent trees grow in a wet ravine, one of them overshadowing the road. The large fig trees with pale trunks and branches growing on the rocky coast at the north end of the island, seen only from a boat, probably represent this species also.

The pallid, rather smooth trunks are 5–10 dm. thick, well buttressed at the base, and may arise 9–12 m. before branching. The somewhat leathery leaves are obtuse or acute at the ends, 13–18 cm. long, 5.5–8 cm. broad, and have a petiole 2–4 cm. long. They have 18–24 strong, parallel major veins on each side of the midrib. The very slender and elongate terminal buds are 6–9 cm. long. The glabrous figs, borne solitary in the leaf-axils on peduncles 1 cm. long, are globose and about 18 mm. in diameter. Though watched closely, this tree was discovered in fruit only once, on Feb. 5, 1946, when maturing figs were found on Canyon Road. The species is known from Guatemala, Honduras, Costa Rica and Panama. (Fl. C. Z. p. 160). *Johnston 1284, 1339.*

Ficus Dugandii Standley

A giant tree which was observed only in the vicinity of Main Camp. Although only about a dozen trees of the species were found, included among them are two of the best-known individual trees on the island, namely the picturesque giant tree near Headquarters and the imposing buttressed giant growing on a ledge and overspreading the main road just outside of the camp area. With the exception of the two individuals mentioned (both about 18 m. high), the species was restricted to the dense Camp Valley forest back of the Motor Pool and the E. M. Barracks. The tree grows 18–28 m. tall, has a dense wide-spreading crown and well-developed, steeply ascending plank-buttresses that commonly extend 3 m. or more up the massive gray trunk. The largest specimen observed, which with a giant *Luehea* stands isolated at the very head of Camp Valley, north of the main road as it leaves Camp, is at least 28 m. tall. The spread of its buttressed trunk at ground level is 7.5 m. The individual buttresses are 1–2 m. wide and 1 dm. thick at the base, and gradually narrowing, are well defined 3–6 m. up the trunk. Several trees in the Camp Valley Forest reach 20–25 m. in height. No other tree on the island has buttresses so spectacularly developed. The large size of its plank-buttresses and the unusual height on the trunk to which they ascend so steeply make it an easily recognized tree.

The leaves are thinner and less rigid than those of other *Ficus* species on San Jose. They are commonly 9–18 cm. long and 4.5–9 cm. wide and broadest below the middle, and are not lustrous. They have an acute or short-acuminate apex, an obtuse or truncate-rounded base, and a slender petiole 3–6 cm. long. There are 9–13 pairs of primary nerves. The terminal bud is 8–15 mm. long. The figs, borne in pairs in the leaf-axils, are globose, 9–15 mm. in diameter, and borne on peduncles 2–5 mm. long. They are matured during February, March and April. The species is known from northern Colombia and Venezuela and from cultivated trees in the Canal Zone. *Johnston 680, 752, 1063, 1381, 1389, 1390.*

A fig tree growing at the foot of the bank on the inner edge of the Back Wash (near the pipe line carrying water to Main Beach) may represent a young tree of *F. Dugandii* or possibly a related unnamed species. It grows in swamp mud associated with *Enallagma, Rhabdadenia, Mora* and *Pterocarpus,* is 15 m. tall, and apparently started as an epiphyte low on the trunk

of a swamp tree. It has several trunks 15–30 cm. thick, and has produced some planklike prop roots 1–1.5 cm. wide and 5–10 cm. thick. The leaves are more flaccid than in *F. Dugandii*, and, though of about the same measurements, tend to be more elongate and to be contracted through an angulate base to a more slender and elongate petiole. The figs are globose and have an unmargined but prominent ostiole as in *F. Dugandii*, but average larger, 13–15 mm. diameter, and are borne on much longer peduncles. *Johnston 1387.*

Ficus glaucescens (Liebm.) Miq.

A tree, 10–20 m. tall, which appears to be rare on the island. An individual of the species grows at the south margin of the yard at the Motor Pool, several grow under palms at Orangetree Beach, some are to be found near the jeep trail along the stream at the east boundary of Area 8B, and more grow in thickets and along the wet ravine on Canyon Road a few hundred yards from the Loop. The trunk is 3–6 dm. thick and may be moderately buttressed or unbuttressed at the base. The twigs are rust-colored. The herbage is dull, dark, rather olivaceous green in color. The stiffish leaves are pointed at both ends, 10–17 cm. long, 4–6 cm. wide, and have the lower surface minutely hairy and scabrous. The veining is distinctive. The 7–10 pairs of primary veins are pallid, prominent, sparingly branched, and joined at their tips to form an unusually prominent, undulate compound vein along the leaf-margin. The terminal bud is 1–2 cm. long. The figs, nearly globose, 13–15 mm. in diameter, borne solitary in the leaf axils on very slender peduncles 5–8 mm. long, are clothed with abundant short soft white hairs. Only one fruiting tree was found on the island. This was discovered early in February on Canyon Road. The species ranges from Mexico to Colombia. (Fl. C. Z. p. 160). *Johnston 449, 533, 1338, 1383.*

Ficus Leavensii, sp. nov. PLATE 16, FIG. 1.

Arbor 10–24 m. alta; ramulis crassiusculis griseis glabris; stipulis 10–18 (saepe 15) mm. longis deciduis lanceolato-acuminatis glabris vel dorse medium basimque versus pilis adpressis sericeis fulvidis vestitis; lamina folii firmiter chartacea oblonga vel elliptica medium versus vel supra medium latiore 12–20 (–25) longa 5–10 (–15) cm. lata glabra, basi late obtusa vel non rariter anguste truncato-obtusa, apice subrotunda vel obtusa vel interdum late breviterque subacuminata, supra saepe dense minutissimeque brunneo-tuberculata glabra venis et costis applanatis prominulis notata, subtus glabra vel subglabra costis et venis prominulis donata basim versus conspicue 3-costata vel obscure 5-costata; venis primariis utroque 7–10 sub angulo 65°–70° abeuntibus marginem versus tenuissime arcuato-conjunctis; venulis tenerrimis reticulatis sed non conspicuis; petiolis 1.5–3 (–4.5) cm. longis; receptaculis geminatis sessilibus glabris depresse globosis in vivo 2–2.7 cm. (in sicco 12–16 mm.) diametro; ostiolo annulo subdeltoideo prominenti 1–1.5 mm. alto 3–4 mm. lato circumdato; involucro bilobato 7–9 mm. lato, lobis in discum saepe glabrum connatis.

TYPE: *Johnston 1125*, San Jose Island, west end of Main Beach, tree 7.5 m. tall.

Ficus Leavensii var. **thinophila,** var. nov.

A forma typica speciei differt foliis subvelutinis, subtus pilis minutis rectis numerosis inconspicuis donatis.

TYPE: *Johnston 1012*, San Jose Island, Playa Grande, tree 9 m. tall with *Hippomane* on beach backed by mangrove swamp.

Usually a small spreading tree, 5–10 m. tall, growing on beaches backed by mangrove swamps, as at Main Beach, Orangetree Beach, and Playa Grande, or on rocky cliffs near the ocean, as at Mango Beach, near South Beach, and on Hicaco Island. However, on the bank forming the landward side of the swamp at Main Beach, and also near the stream at the east side of the yard at the Motor Pool, the tree grows not as a self-supporting tree, but as a strangler which grows upon, kills, and replaces forest trees and becomes as much as 24 m. tall. With the exception of one individual growing on the banks of the Rio Marino, near its junction with the stream from the North Fork, the tree was seen only within a quarter of a mile from the shore. When growing as a self-supported tree its trunk is of moderate size and at most only weakly buttressed. Most of such trees appear to have started from seeds germinating in the soil. A few may have started as epiphytes developing low on a tree trunk.

The leaves are oblong to elliptic, usually broadest at or above the middle, and commonly 12–20 cm. long and 5–10 cm. wide. They are usually rounded to obtuse at the ends, and commonly have 7–10 pairs of veins. They may be glabrous or covered with minute grayish hairs. The globose figs are borne in pairs in leaf-axils. They differ from the figs of other species found on the island in being without stalks. They are clearly sessile and become 1.5–2.5 cm. in diameter.

The species is known only from San Jose Island. It is closely related to the Panamanian *F. Williamsii* Standley, but differs in having longer petioles and in having the veins and midrib on the upper leaf-surface moderately prominent rather than impressed. The type of *F. Williamsii* has petioles varying from 12–17 mm. in length but commonly 15 mm. long. Its figs agree closely with those of the island plant in size, shape, and attachment, as well as in involucre and ostiole. The relationships between the island plant and that of the mainland may prove too close for continued specific separation, but in such case the name given to the plant of San Jose will stand, since the binomial *F. Williamsii* Standley (1917) is antedated by the homonym *F. Williamsii* C. B. Robinson (1908). I find it a pleasure to associate with this tree the name of Colonel Donald W. Leavens, now resident at Summit, N. J., who directed the extensive construction work on the island. His bulldozers, directly and indirectly, contributed much to my botanical work on San Jose.

Ficus panamensis Standley

An epiphytic tree occasional in the forests and high thickets in all parts of the island. Its habit of growth is unusual. The pole-like stems, bearing at intervals radiating clusters of simple, leafy branches a meter or less long, project stiffly 2–5 m. out from the supporting tree or forest canopy. The plant appears to start its growth from seeds germinating in the crotches, or on the bark of limbs, high in trees. The epiphyte anchors itself in the crown of the host by growing about and partially strangling some limbs of the latter and then develops elongate branches which crowd out and overtop those of its victim. One or more roots 5–10 cm. in diameter are sent down to the ground along the trunk of the host, but never strangle it. The epiphyte continues to use its living host as support. Because its stems project above those of

its host they are consequently exposed to the full sweep of the wind and are at times torn from their attachment. The large branches of the plant are occasionally found dead on the forest floor or seen dangling inside the forest.

The whorled branches and what appear to be nail-like adventitious roots produced near the latter along the main stems offer ideal support for earthen ant nests. Indeed, these ant nests, commonly supporting a growth of *Epidendrum imatophyllum* and *Codonanthe decurrens*, are so numerous on the tree that they are one of its distinctive features. When the plant is disturbed ants swarm over it in incredible numbers. The collecting of a specimen of this *Ficus* can be a very disagreeable task because of them.

The elongate leaves, which are not thick, are broadest above the middle, 1–2 dm. long and 3.5–8 cm. wide. The narrowed base is rounded or somewhat cordate and has a petiole 1–4 cm. long. The leaf apex is rounded or obtuse and abruptly contracted into a well-developed, deflexed, acuminate tip. The elongate terminal bud is 15–30 mm. long. The figs, appearing in February and March, are obovate when young but become globose and 10 13 mm. in diameter when mature. They have a short stout peduncle 1–2 mm. long and a dark, prominent, conspicuous ostiole. The species ranges from southern Mexico to Panama and Colombia. *Johnston 596, 627, 651, 1134, 1174, 1365, 1409.*

Ficus Popenoei Standley

A tree 10–20 m. tall, occasional on the northern half of the island in the drier forests north and east of the Marino watershed. No young plants were seen. Many of the old specimens appear to have developed as normal forest trees from seeds germinating in the ground. Some, however, evidently started life as epiphytes and may be seen in the various stages of strangling, killing, and replacing their host in the forest. A few individuals have developed the banyan habit, the only examples of this unusual growth form on the island. Though these particular trees had the habit well developed, the other trees of the species seen on the island showed absolutely no tendencies towards this type of growth. A fine specimen of this tree with banyan habit, known to most of the personnel on the island as a botanical curiosity, grows on the boundary between Areas 8A and 8B, a few hundred yards north of East Road. It has produced a great number of secondary trunks, which have developed from aerial roots evidently dropped down from the branches in its broad crown. Two other specimens with similar habit were noted in Area 11B. In its ordinary form the tree has a gray or russet trunk, which is usually 4–8 dm. thick, irregular in cross section, and in most cases irregularly and deeply fluted at the base rather than buttressed. The bark is smooth or somewhat scaly.

The leaves, twigs and fruit are velvety with abundant short, brownish hairs. The leaves are ovate to elliptic, 10–15 cm. long and 7–10 cm. wide. The apex of the leaf is rounded or obtuse and not acuminate, while its narrowed base is usually somewhat cordate or rarely obtuse. The petiole is 6–15 mm. long. The upper surface is harsh to the touch, with the midrib and 7–9 pairs of principal veins usually somewhat prominent, while the secondary veins are usually obscure and not at all impressed. The petiole and prominent midrib and veins on the lower surface are minutely velvety with orange-brown hairs. The terminal bud is 6–10 mm. long and usually plump. The tawny

figs, maturing in November, are ellipsoidal or ellipsoidal-obovoid, 1.7–2.5 cm. long, 1.3–1.8 cm. thick and in shape unique among American figs. Their ostiole is neither prominent nor noticeably margined. The peduncle is 2–3 mm. long.

Previous to its discovery on San Jose the tree has been known only from British Honduras, Honduras and adjacent Guatemala. *Johnston 483, 640, 660, 804.*

Ficus Standleyana Dugand

A small tree, 3–9 m. tall, occasional in high thickets or in low forest in all parts of the island. Some trees appear to have started from seeds germinating in the soil. When less than 3 m. high they tend to recline more or less on surrounding woody vegetation. Generally, however, the plant seems to start as an epiphyte on branches of bushy trees, its stems clasping those of the host and its leafy branches mingling with those of the host or here and there crowding them out and replacing them. Though the plant handicaps its host it does not appear to kill it. Occasionally it grows at some distance from other trees. A few such grew under the palms at Orangetree Beach. At several places on the island it was found rooted on the top of large rocks. The tree fruits abundantly. Numerous fruiting individuals were found during each of my three visits to the island.

The species has elongate, usually oblong or rarely somewhat lanceolate leaves 1–2 dm. long and 5–9 cm. wide. The leaves are not very thick. They are twice as long as broad, with the base usually rounded or rarely obtuse and the apex abruptly contracted into a deflexed acumination. Their slender elongate petiole is 3–7 cm. long. The terminal buds are 7–15 mm. long. The figs are borne in pairs in the leaf axils and are globose or globose-obovoid, 8–12 mm. in diameter. They have slender peduncles 2–8 mm. long, and non-prominent ostioles.

The species ranges from southern Mexico to Panama, Colombia and Venezuela. The species has had a number of non-valid names. Those to be discarded because of earlier homonyms are *F. verrucosa* (Liebm.) Hemsley (1883), non Miq. (1867); *F. Hemsleyana* Standley (1917), non King (1887); and *F. turbinata* Pittier (1937), non Willd. (1806) nec Miquel (1867). (Fl. C. Z. p. 160, sub *F. Hemsleyana*). *Johnston 109, 494, 598, 777, 958, 1051, 1077, 1168, 1177.*

PROTEACEAE

Roupala complicata HBK.

A forest tree which is most common at the southern end of the island, being frequent on the road back of South Beach, on the Navy Road, and on the Navy Cove Road, and occasional along South Road as far north as Area 2A. It is one of the characteristic elements of the South Forest. Only a few trees were observed outside this type of forest. A few grow along East Road several hundred yards west of the Marino Bridge and along the Loop just west of the start of Little Butch Trail, in both instances at the margin of Marino Forest.

The tree is commonly 10–15 m. tall with a trunk 15–25 cm. thick. The largest seen was 22 m. tall and had a trunk 45 cm. thick. The leaves of young and old trees differ remarkably in size and form. Seedlings and young trees

up to several meters high have pinnate leaves 15–30 cm. long, bearing numerous toothed leaflets. Mature trees have simple leaves with either toothed or simple margins, which in general size and form suggest those of a Poplar or Cottonwood. On trees approaching maturity both types of leaves may be found, as well as all transitional forms between them. The tree flowers late in January, at which time it is covered with slender spikes of cream-colored flowers which, massed on the tree, seem pale yellow in color. The fruit, a flat pod, elliptical in outline, is probably matured and shed quickly, for I found none on the trees when I arrived on the island the middle of March 1945. The tree starts to renew its foliage and put forth new shoots either just preceding or just following its period of flowering. The wood of the tree and its crushed foliage have a characteristic slightly offensive odor that has been described as "skunk-like," but which to me is more suggestive of that of a freshly opened tin of canned salmon.

The species ranges from Costa Rica and Panama to Venezuela and northern Colombia. (Fl. C. Z. p. 166, sub *R. dariensis*). *Johnston 331, 348, 1285, 1292, 1293, 1368.*

OLACACEAE

Ximenia americana L.

A coastal tree armed with spinescent branchlets, growing on the barrier beach next a mangrove swamp at Playa Grande, Orangetree Beach, and Long Beach. At Orangetree Beach it is a sprawling tree 6 m. tall with a trunk 2 dm. thick, growing under palms on the beach. At the other stations it is an erect, bushy tree 6 m. tall, in a thickety growth. The small flowers have white recurving petals that are conspicuously hairy on the inner face. The ellipsoidal fruit, 2.5–3 cm. long, is a smooth stone covered with a thin, yellowish, edible flesh, slightly acid in flavor. The species is widely distributed on tropical coasts of both hemispheres. (Fl. C. Z. p. 168). *Johnston 719, 774; Erlanson 149.*

LORANTHACEAE

Struthanthus orbicularis (HBK.) Blume

A slender-stemmed viny mistletoe forming tangled masses in tree tops. It is common in all parts of the island and parasitic on a great variety of different trees. Though most readily seen on bushy trees in thickets, it is probably most abundant in the forest canopy. The stems are slender, elongate and weak, and usually about a meter long. They are commonly very numerous and much branched, and occur in tangled masses. They exhibit habits and structures ordinarily found only in vines, but apparently useful to this parasite in tying its slender stems to the branchlets of its host and spreading them through the tree tops. The vigorous new shoots twine about their support. They also produce adventitious roots from the bases of the petioles that can develop into haustoria but, more commonly, grow about a supporting twig and serve as clasping organs. Young leaves developing on these shoots also serve as grappling devices. Their petioles grow more rapidly than the blade, becoming fully grown, hardened and recurving before the blade enlarges, thus forming hooks that hold the stems to the crown of the tree as they lengthen. The slender elongate stems of the parasite which might be lashed about by high winds are accordingly very securely held to

the tree on which they grow. The opposite leaves are usually 2–4 cm. long and elliptic to nearly orbicular in form. The small yellowish flowers are borne in loose racemes and appear to develop most abundantly during March, April, and May. The species is found in Central and northern South America. (Fl. C. Z. p. 167). *Johnston 518, 641, 1144; Erlanson 73, 564; Harlow 10.*

ARISTOLOCHIACEAE

Aristolochia Chapmaniana Standley

An inconspicuous slender, twining vine which has been observed in thicket areas in various parts of the island. It has been seen back of the Playa Grande mangrove swamp, near the Motor Pool, at the foot of Red Hill Grade, along Canyon Road, and in Area 11B. Near the Motor Pool numerous young plants were observed in second growth, but elsewhere it was found only in old thicket. It is a very unobtrusive plant, which I found difficult to detect even when I was trying to relocate plants I had under observation. I suspect it is much more common in the thickets of the island than the few stations listed might indicate.

The leaves, which have prominent reticulate veining beneath, are oblong, 8–18 cm. long, 2.5–7 cm. wide. Their apex is acute and their base strongly eared. The dark tubular flowers are about 12 cm. long and appear during the first half of the dry season. The 6-ribbed capsules are 5–6 cm. long and about 3.5 cm. thick. They are obtuse at the apex and contracted at the base into a stipe 3–4 cm. long. The species is known only from San Jose and the Canal Zone. (Fl. C. Z. p. 169. sub *A. maxima*). *Johnston 726, 1253, 1316; Erlanson 424.*

POLYGONACEAE

Coccoloba Waittii n. sp. PLATE 14, FIG. 2.

Arbor vel frutex 3–10 m. altus; ramulis glabris sulcatis pallidis; ochreis adpressis glabris 5–15 mm. longis oblique truncatis, supra medium membranaceis mox deciduis, infra medium coriaceis pallidis arcte adpressis tarde deciduis cicatricos relinquentibus; foliis variabilibus lanceolatis vel ovatis saepe medium versus sed non rariter supra medium latioribus saepissime 8–20 cm. longis et 4–12 cm. latis, apicem versus in acuminem abrupte vel gradatim attenuatis, basim angustam vel latam et truncatam vel cordatam versus saepe attenuatis, supra glabris, subtus pallidioribus glandulis minutissimis obsitis secus costa et nerviis prominentibus pilis inconspicuis erectis albis donatis alibi glabris; costa in facie superiore laminae infra medium plus minusve impressa supra medium applanata, facie inferiore prominentibus; nervis primariis utroque latere costae saepe 9–11 in facie superiore subtiliter prominulis, facie inferiore prominulis densissime reticulatis; petiolis 5–10 (–20) mm. longis pallidis glabris, supra vix sulcatis; inflorescentia terminali racemosa foliis breviore 5–10 mm. longe pedunculata 7–10 cm. longa laxiflora; pedicellis 1–2 mm. longis divaricatis; floribus ignotis; fructu subovoideo 8–10 mm. longo 5–7 mm. crasso, basi rotundo saepe in stipitem abrupte contracto, apice rotundo vel conico lobis perianthii persistentibus conniventibus conspicue coronato; pericarpio carnoso rubro ad nigro; endocarpo conspicue 15-costato.

TYPE: *Johnston 230,* San Jose Island, Area 8B, tree 3–6 m. tall on thin soil.

A shrub or small tree, 3–10 m. tall, growing on islets and about cliffs and on many of the areas of thin soil about the island. The leaves vary greatly

in size and form, even on a single plant, especially so as to width. They are firmly chartaceous in texture, lanceolate to broadly ovate, 8–20 cm. long and 4–12 cm. broad, and usually acuminate-tipped and broadest near the middle. They are gradually contracted below the middle but tend to be truncate or cordate at the very base. The petiole, 5–20 mm. long, springs from the side of a collar-like ochrea that sheathes the stems above each node. This ochrea, or stipular sheath, fits very tightly about the stem and is at first 5–15 mm. long, but in age is shorter because of the disintegration of its upper half. It provides a distinctive structure by which this *Coccoloba* can be readily distinguished from all other woody plants known on San Jose. Flowers of the species have not been collected. They are borne, however, in slender elongate racemes, probably at the close of the dry season. The fruits are ellipsoidal or ovoid, 7–10 mm. long, and have a juicy flesh surrounding a pointed, distinctly ribbed stone. They are at first red but finally become black when fully ripe and are borne many together in elongate racemes about 1 dm. long, chiefly during the middle of the rainy season.

The species is known only from San Jose and from one locality in Panama (Pese, Herrera, *Allen 802*). Among its salient characters are the strongly ribbed stones, the pointed firm-chartaceous leaves, and the tight ochrea coriaceous below the middle. It is a well marked species. It has been associated with the name of Major General Alden H. Waitt, Chief of the Chemical Corps. *Johnston 213, 230, 975, 1306; Erlanson 216, 377, 550; Harlow 41.*

RUMEX ACETOSELLA L. SHEEP SORREL

A dozen or more plants of this widely distributed temperate weed were found about the Goat Barn in January 1946. The plants were well established but sterile and had undoubtedly been introduced from the United States in unclean hay.

RUMEX DOCK

A species of Dock, present as leaf-rosettes only, was found growing about the Goat Barn and in the lawn near Headquarters in January 1946. Without flowers and fruit it cannot be identified, but it seems likely that either *R. crispus* L. or *R. obtusifolius* L. may be represented.

AMARANTHACEAE

ALTERNANTHERA FICOIDEA (L.) R. & S.

In March 1945 a number of plants of this introduced weed were found growing about the Guest House at Camp. By January 1946 it was to be found in all parts of Main Camp and had appeared on the roadside of the Cross Roads. The species is widely distributed in tropical America. (Fl. C. Z. p. 174). *Johnston 646; Erlanson 182; Harlow 35.*

AMARANTHUS ALBUS L.

A small fruiting plant was found in the corral at the Goat Barn in January 1946. This is a temperate species probably introduced in unclean hay. *Johnston 1151.*

AMARANTHUS DUBIUS Mart.

Collected by Erlanson in waste places near the Navy Station in June 1945. I found no evidence of this tropical weed in 1946. (Fl. C. Z. p. 173). *Erlanson 350.*

AMARANTHUS HYBRIDUS L.

Collected in January 1946 near the Goat Barn and in the lawn at Main Camp. This weed is widely distributed in temperate and tropical America. *Johnston 1147, 1156, 1195.*

AMARANTHUS RETROFLEXUS L.

Collected at the Goat Barn by Erlanson on May 22, 1945. Although searched for, no plants of the species were found in the vicinity of the Barn in January 1946. The plant had been introduced from the United States in unclean hay. *Erlanson 188.*

AMARANTHUS SPINOSUS L.

Several thrifty colonies of this spiny weed were found in and about the corral at the Goat Barn. The plant was probably introduced in unclean hay. (Fl. C. Z. p. 173). *Johnston 1158.*

CELOSIA ARGENTEA L.

This wild form of the garden Coxcomb, a weed in tropical America, was found in January 1946 in the lawns at Main Camp and on rubbish piles at the Garbage Dump. (Fl. C. Z. p. 172). *Johnston 984.*

Iresine angustifolia Euphr.

An herbaceous annual, 5–15 dm. tall, occasional in disturbed places along roads through thicket areas, along the northern and eastern portions of the Loop, along Dead End Road, and along East Road near the Air Strip. The plant has an erect central axis and numerous ascending branches when young, but when grown large may be more or less reclining on bushes. In 1946 it grew very rapidly during January and had flowered and died down by mid-February. The species is widely distributed in tropical America. (Fl. C. Z. p. 174). *Johnston 1326.*

CHENOPODIACEAE

CHENOPODIUM MURALE L.

Occasional as a weed in the hospital lawn in January 1946. *Johnston 1206.*

CHENOPODIUM LEPTOPHYLLUM Nutt.

A few plants were flowering and fruiting in the corral at the Goat Barn in January 1946. They were probably introduced from the United States in unclean hay. *Johnston 1230.*

NYCTAGINACEAE

BOERHAVIA COCCINEA Mill.

A prostrate glandular weed well established on Main Beach and along the road behind it in January 1946. It was first collected on the island by Harlow at Main Beach in September 1945. Widely distributed in the warmer parts of America. (Fl. C. Z. p. 176, sub *B. caribaea*). *Harlow 47.*

PHYTOLACCACEAE

Phytolacca rivinioides Kunth & Bouché POKEWEED

A coarse perennial herb, a meter tall, growing along the road leading to Englishman and Observer Beaches. It was first seen in March 1945. A year later it had not increased much in numbers. The species was not introduced during Army occupation of the island. It occurs at the margin of an area which seems to have been cleared, cultivated and abandoned years ago, and perhaps may have sprung from seeds persisting from an early settlement on the island. The species is widely distributed in tropical America. (Fl. C. Z. p. 176). *Johnston 509; Erlanson 10.*

AIZOACEAE

MOLLUGO VERTICILLATA L.

A small prostrate weed, common in the corral at the Goat Barn in January 1946. The species is widely distributed in warmer parts of America and was probably introduced onto the island in unclean hay. (Fl. C. Z. p. 177). *Johnston 1232.*

Sesuvium Portulacastrum L.

A very fleshy plant with narrow thick leaves and small pink flowers, which trails on the sand at Playa Grande, on E. M. Beach and on the beaches in Bodega Bay. The plant is widely distributed along sea coasts in the tropics. (Fl. C. Z. p. 177). *Erlanson 173.*

PORTULACACEAE

PORTULACA OLERACEA L. PUSLEY

This small juicy weed was observed in the lawn at Main Camp and about the Physiological Laboratory in January 1946. It is widely distributed in temperate and tropical regions. (Fl. C. Z. p. 177). *Johnston 901.*

ANONACEAE

ANONA GLABRA L.

A young, bushy tree about 3 m. tall, which was fruiting in January 1946, grows next to the road between the Post Exchange and the E. M. Mess on a bank made by the bulldozers in leveling ground for the latter building. The ovoid fruit, 7–8 cm. long, 5–6 cm. thick, has a smooth yellow skin and contains many seeds embedded in a very firm orange pulp of not disagreeable flavor. At maturity, while still very firm, the fruit becomes loosened from its core and drops to the ground, leaving the latter attached to the tree.

The species grows in tropical America and west Africa, usually in wet places near the coast. It is evidently not native in the only place it has been found on San Jose and is not a tree that would be deliberately planted. Possibly it may have sprung from the rejected seeds of a fruit brought to the island by some undiscriminating workman for use as food or medicine. In any case, now that it is established it will probably spread, for it grows well on the island and produces abundant seeds. (Fl. C. Z. p. 180). *Johnston 1223.*

Anona purpurea Moc. & Sesse

A spreading tree, 10–15 m. tall, found scattered in open forests on the eastern side of the island, most abundantly on the peninsula east of Red Hill. The leaves are large, 15–30 cm. long, 10–16 cm. wide, and have many prominent nearly parallel veins. They resemble those of *A. Spraguei* but are proportionately broader and are not pallid beneath. The tree is usually leafless during most of the dry season. The very coarse flowers, 3 cm. long, have thick elongate purple petals and are produced while the plant has naked branches. No fruit was seen on the island. The fruit is said to become 15 20 cm. in diameter and to be roughened with numerous pyramidal protuberances and clothed with a brown felty tomentum. It has a mango-flavored, orange fibrous pulp with embedded seeds, and can be eaten. The species is found from Mexico to Panama and in Venezuela. (Fl. C. Z. p. 180, plate 28). *Johnston 738.*

Anona Spraguei Safford

A tree 10–20 m. tall, occasional in forests in all parts of the island. The large lanceolate-oblong leaves, 20–33 cm. long, 7–11 cm. wide, have numerous nearly parallel veins and are pallid beneath. The tree flowers and renews its foliage after having had its branches naked for a time during the middle of the dry season. The very coarse flowers, about 2 cm. long, have thick triangular yellowish petals. The fruit, the size of a tennis ball and bristly with abundant slender, recurved processes 5–10 mm. long, is matured at the close of the rainy season. It has a fragrant, sweet, yellow or orange flesh of fair flavor, but is seldom obtainable, since it is usually eaten by birds, or, falling to the ground, is promptly consumed by wild pigs. A number of trees of this species, as well as *A. purpurea*, are readily seen and accessible from the jeep trail into Area 8B, and fruits from them could be obtained if they were kept under observation during the latter half of the year. The species is known only from Panama. (Fl. C. Z. p. 180, plate 27). *Johnston 286, 304, 743.*

Xylopia aromatica (Lam.) Mart.

A loosely branched tree, 3–10 m. tall, which is frequent locally about the edge of the forest margining the grassland on Bald Hill. Elsewhere it was found in limited numbers at only two other stations on the island. A few trees grow in open forest near the north end of the jeep trail to Central Met. Station, and a few grow in high thickets on a slope along the switch-backs on Navy Cove Road. A collection made by Andersson during his visit to San Jose in 1883 indicates that the tree also grows on the northeast coast of the island. The leaves are lanceolate, 7–13 cm. long. The elongate, stalked, red fruits are borne in dense clusters, 4–5 cm. in diameter, along the naked older portions of the branchlets. The species ranges from Cuba and Costa Rica south to Paraguay. (Fl. C. Z. p. 181, sub *X. xylopioides*). *Johnston 33; Erlanson 298; Andersson.*

Xylopia frutescens Aubl. MALAGUETO

A common and readily recognized tree on San Jose, growing in forests and in high thickets bordering them. Its appearance is distinctive. The pale trunk is commonly 10–15 cm. thick, usually 6–18 m. tall, and noticeably

roughened by enlarged old leaf-scars. The crown is nearly flat and rather dense, 2.5–5 m. in diameter and less than half as deep. The branches, crowded at the top of the elongate, slender cylindrical trunk, are flat and horizontal and clothed with myriads of small lanceolate leaves 2.5–5 cm. long. From a distance they are suggestive of a large fern frond. The small fruits, borne singly or in small clusters on leafy twigs, are pink or yellowish. At maturity they split open and reveal a red interior. The species ranges from Guatemala south to Brazil. (Fl. C. Z. p. 181). *Johnston 199, 220, 375, 616; Erlanson 192.*

MENISPERMACEAE

ABUTA spp.

Fruits of apparently two species of this genus were found from time to time washed up and lodged in drift on the beaches on Bodega Bay and E. M. Beach, PLATE 10, FIG. 4. They are somewhat asymmetric, strongly biconvex, 3–4 cm. long, 1.9–3 cm. high, and 1.8–2.1 cm. thick, and contains a single large, strongly bent and conspicuously ruminate seed that was dead or dying when found.

The common sort has a firm, bony shell which is marked with an elaborate over-all pattern of fine lineate grooves as well as by some deep, short, coarse grooves on the sides and by two parallel rows of numerous deep pits down the rounded dorsal edge. Many of the fruits had these markings sharp and clear, but others, variously weathered and worn, had lost in varying degrees the finer markings. Some, in fact, were practically smooth and had only the parallel rows of dorsal pits remaining as decoration. Though obviously fruits of some Menisperm, they are utterly different from those produced by any member of that group of vines known from Panama or Central America. Since Dr. Harold N. Moldenke had made a special study of the South American *Menispermaceae,* samples of the fruit were sent to New York for his examination. He reported as follows: "The plant producing them most certainly was a species of *Abuta.* In fact, the largest of your fruits match almost perfectly a fruit of *A. panurensis* Eich., which Froes collected in the basin of the Rio Negro, Amazonas, Brazil (his no. *12414/158* in the Britton Herbarium). However, this species is not known outside of the state of Amazonas, Brazil, and I would hesitate to identify your fruit as *A. panurensis* for this reason, in spite of the striking similarity of fruits. There is, however, another species of *Abuta, A. colombiana* Moldenke, which was described from Choco, Colombia. It seems to be closely related to *A. panurensis,* but the fruits are not known. I would not be surprised if your fruits are the fruits of *A. colombiana.* Until we get any evidence to the contrary I would be inclined to identify them thus, with an interrogation point."

Among the *Abuta* fruits found on the beaches of Bodega Bay there is one (PLATE 10, FIG. 4, far left) which apparently represents a second species of the genus. In size and form and in the structure of seed it is similar to the common *Abuta* fruit of the beaches, but differs in having a thinner shell and in lacking the fine lineate markings and the deep pits and grooves. It is roughened by a few very broad, well-marked, more or less concentric tumulose ridges. Dr. Moldenke suggested that it was a different species but did not venture an identification of the plant producing it.

Odontocarya nitida Riley

A slender vine most common on and near the coast of the island, particularly in places with thin soil that becomes very dry during the rainless season. It trails over rocks and bare ground, climbs in bushes, or twines high in trees in open woods. It is found on many of the rocky sea cliffs, on most of the rather barren rocks and islets along the shore, and is usually present in bits of deciduous forest located on and near the coast. Back from the shore it is locally common on the west side of the road midway between the Guard House and the Supply Office, where it climbs a tree and trails over the ground in the surrounding clearing.

In general appearance and habit the plant is suggestive of a *Dioscorea*. The old stems become a centimeter thick and are herbaceous, thick and juicy. Most of the stems, however, are very slender and elongate and rarely exceed 2–3 mm. in thickness. The leaves, 4–8 cm. long, are somewhat three-lobed or are roughly heart-shaped. Their lower surface is finely pubescent and between the base of the midrib and the lowest diverging veins bears small characteristic glandular areas. The small green flowers are borne in scattered clusters along a leafless, axillary flowering shoot, 5–10 cm. long. The plants on the road to the Supply Office flowered during my three visits to the island, covering the period from September to May, but produced no fruit. The only fruit discovered on the island was found April 25, 1945, on a vine, then renewing its foliage, which twined high in a tree near East Harbor. The carpels, 1–3 per flower, were about 8 mm. long, green, and provided with a thin juicy flesh. The species is known only from Panama and northern Colombia. (Fl. C. Z. p. 179). *Johnston 7, 786; Erlanson 546, 581.*

LAURACEAE

(Identifications by C. K. Allen)

Nectandra Gentlei Lundell

A bushy tree, 3–9 m. tall, scattered in thickets in all parts of the island. It occurs in perhaps its greatest abundance along Canyon Road but even there is not very common. The tree has very slender and elongate, and rather lax and drooping leafy twigs. The leaves are slenderly lanceolate, 10–20 cm. long, 2–4 cm. wide, and have elongate attenuate tips. They turn crimson before they are shed. Some scattered crimson leaves are usually to be seen among the prevailingly green herbage of the trees. This unusual coloration, along with the rounded, bushy habit of growth and the slender elongate lax branchlets of this plant, gives it a very distinctive aspect. The tree, apparently, can be found in flower and fruit most months of the year. The inflorescence, pedicels and calyx are green or yellowish when bearing fruit, and do not become red as in the island species of *Ocotea* and *Nectandra*. The ellipsoidal berry, 8–10 mm. long, is green when ripe. The species is known from northeastern Central America and Panama. (Fl. C. Z. p. 184, sub *N. Pichurim*). *Johnston 82, 221, 270, 521, 699, 716; Erlanson 19, 174, 531, 565.*

Ocotea rubrinervis Mez

A species widely distributed on San Jose but nowhere common. It is a small tree 5–15 m. tall which is occasional in high thicket and forest. The stiff elliptic leaves are 6–12 cm. long and 3–7 cm. broad. Their midrib and

the sparingly branched veins are rather pale and very prominent on the lower surface and somewhat impressed on the upper surface. The mature ellipsoidal berry, about 13 mm. long, is dark green, but the calyx, pedicels and inflorescence bearing them are frequently reddish, especially where growing exposed to strong sunlight. The flowers are yellowish. They appear most abundantly in January. The fruit matures in February and has usually fallen by early March. The species is best known on San Jose, elsewhere being known only from a few collections made in Panama, Colombia, Peru and Bolivia. *Johnston 111, 133, 250, 415, 497, 556, 563, 604, 655, 1406; Erlanson 512.*

Phoebe Johnstonii Allen

A tree rather common in forests and high thickets in all parts of the island. In thickets it is bushy in form and 3–7 m. tall, but in forests it grows 10–20 m. high and develops a trunk 2.5–5 dm. thick. Many of the larger trees of this species produce numerous slender sucker-shoots from rough swollen areas near the base of the trunk, a habit unusual in the shady tropical forest. The twigs are frequently reddish. The leaves are lanceolate, 8–14 cm. long and 2.5–4.5 cm. broad, and never so attenuate apically as in the island *Nectandra*. They differ from the leaves of the island *Ocotea* in tending to be more elongate and in having their lowest pair of veins differing from the others in the blade by being opposite, longer and more steeply ascending. The veins on the leaves of this *Phoebe* are, furthermore, much more branched and less prominent than they are in the *Ocotea*. They are not impressed on the upper surface of the blade. The tree renews its leaves and flowers early in February, and for a time is rather conspicuous because of its fresh green foliage and numerous yellowish inflorescences. The ellipsoidal berry, 8–10 mm. long, is dark green. The fruit-bearing calyx, pedicels and inflorescence are usually reddish. The species is known only from San Jose and from a single collection made on the hospital grounds at Ancon. *Johnston 505, 512, 553, 583, 666, 667, 697* TYPE, *713, 773; Erlanson 16.*

CRUCIFERAE

BRASSICA NIGRA (L.) Koch — WILD MUSTARD

Scattered plants were observed in the lawns at Main Camp and about the Goat Barn. This European weed is rare in the tropics and was probably introduced on the island in unclean hay and spread to the Camp area by goat manure used as fertilizer. The plants were flowering during the early months of 1946, but not maturing fruits. *Johnston 1197, 1240.*

CAPPARIDACEAE

Capparis Baducca L.

A shrub or small tree, 2.5–5 m. tall, locally rather common in a restricted area along the jeep trail in Area 11B. It grows at the margin and in the shade of palm thickets and moderately high streamside forest. The broadly lanceolate leaves, 10–15 cm. long and 3–7 cm. broad, are pale beneath and lustrous green above. The flower buds, 9 mm. long, are green or reddish. The petals are white or greenish white with a reddish medial streak. They fall soon after the bud opens, leaving the dense whorl of stamens, white with the

basal quarter purple, the attractive part of the flower. The gynophore at anthesis is red or white with the ovary contrastingly green. I found the plants flowering during all months from January to May. The species ranges from Mexico and the West Indies south into northern South America. (Fl. C. Z. p. 186). *Johnston 768.*

Cleome pilosa Benth.

This plant was collected by Harlow at Navy Cove in October 1945. He describes it as a weed nearly a meter tall and its flowers as very light blue. It was flowering and fruiting. I searched for the plant in 1946 but could find no traces of it. The plant could be native or have been recently introduced. It is a coarse herbaceous plant with palmately compound leaves. The species, a variable one, especially as to indument, is found in Central America and northwestern South America. (Fl. C. Z. p. 185). *Harlow 92.*

PODOSTEMONACEAE

Tristichia concinna (Liebm.), comb. nov.

This small aquatic herb is locally common along a short, unshaded stretch of the Rio Marino, where it flows over a series of horizontal ledges of rock less than 150 yards north of the Red Hill Bridge. During the rainy season there is a rapid in this section of the stream. During the dry season, however, the water flows quietly at a depth of only a few centimeters. Direct sunlight reaches the stream here at all seasons. These are ideal conditions for this group of plants, but represent a combination of factors to be expected rarely on San Jose. The species may not occur elsewhere on the island.

The plants are mosslike and grow in small clumps on sunny, submerged rocks. Their stems are 3–10 cm. long, have numerous ascending branches, and are covered with minute scale-like leaves 0.5–1 mm. long. When discovered in February 1946 the plant was sterile. Its minute flowers are developed, probably late in the dry season, when stems are partially exposed during the period of maximum low water.

The species is found in Cuba and from southern Mexico to Colombia. It has been incorrectly identified with *T. hypnoides* (St. Hil.) Spreng. of Brazil, from which it is quickly distinguished by having more crowded and regularly arranged leaves. It never has the short, broad, spreading, irregularly arranged and irregularly toothed leaves on the main stems as commonly found in the Brazilian plant. Our plant was first described from Mexican specimens as *Potamobryon concinna* by Liebmann, Förhandl. Skand. Naturf., Copenhagen, 1847, **5:** 513 (1849). At the same time Liebmann described two other related species from Mexico, *P. laxum* Liebm., l. c. 514, and *P. patulum* Liebm., l. c. 515, but these are evidently ecological forms of the present plant, as may be seen from the good illustrations of Liebmann's types published by Warming, K. Danske Vidensk. Selsk. VI, Nat. **11:** 25–27, fig. 20–21 (1901). (Fl. C. Z. p. 186, sub *T. hypnoides*). *Johnston 1320.*

ROSACEAE

Chrysobalanus Icaco L. ICACO

A shrub 1–2 m. tall, growing flattened against cliffs and steep slopes in exposed places along the coast. It has been found only on the bluffs of Punta

del Cabo, on Hicaco Island, and on the bluffs a few hundred yards north of South Beach, but no doubt occurs elsewhere along the rough coast of the island. The leaves are broadly obovate or nearly orbicular, 4–6 cm. broad, obtuse at the base, rounded or obtuse at the apex, and light green in color. The flowers are inconspicuous. Ripe fruit collected on Hicaco Island is globose, 2.5–3 cm. in diameter, rose-colored or white with pink cheeks, and rather suggestive of a tiny nectarine. It has a firm, white, nearly juiceless and tasteless flesh about 4 mm. thick surrounding the central stone. The latter is globose-ovoid, 15–20 mm. long, 13–19 mm. broad and roughened by six or more usually branched ridges which run from the base to near the apex. It contains a single globose seed. The islet at the south end of San Jose was doubtless called Hicaco Island because the early chart-makers happened to encounter the plant there. The plant, however, is not common or conspicuous on the islet.

The species is widely distributed along tropical coasts in America and is also found in West Africa. Its fruits are disseminated by ocean currents. I noted a few of them washed up on the beaches of San Jose. (Fl. C. Z. p. 188). *Johnston 292, 802, 938; Erlanson 78.*

Hirtella americana L.

A rather common tree in the forests and high thickets in all parts of the island. As a tree it is commonly 6–18 m. tall and rarely as much as 20 m. in height. The trunk is 1–3 dm. thick. The twigs are brown and velvety and the lower surface of the oblong or lance-oblong, acute leaves (8–12 cm. long, 3.5–5 cm. broad) is sparsely so. The tree, accordingly, has a characteristic brownish green color by which it can be recognized. During March and April it produces numerous elongate clusters, 10 cm. long and 2.5 cm. broad, bearing pink flowers with conspicuous stamens. The lustrous black fruit is elliptical or oblong in outline, more or less biconvex, and 2 cm. long and 1 cm. broad. The species is found in Cuba and from British Honduras and Guatemala to Colombia. (Fl. C. Z. p. 188, sub *H. mollicoma*). *Johnston 513, 546; Erlanson 108, 121.*

Hirtella oblongifolia DC.

A very common shrub growing in the shade of forests in all parts of the island. It is usually 1.5–3 m. tall but rarely may become a slender tree over 10 m. high. Its trunks are usually only 2–5 cm. thick. The pointed leaves are usually 5–10 cm. long and 2–3 cm. broad. The plant flowers sporadically at all seasons, but its principal flowering period may be in January, since during that month in 1946 it was blooming in great profusion in all parts of the island and for a time was the most conspicuous and decorative in the forests. The small pink or purplish flowers with very conspicuous stamens are borne in slender loose racemes 1–1.5 cm. long.

The species ranges from southern Mexico to Panama. This Central American shrub is separable from *H. racemosa* Lam., a widely ranging species of tropical South America with which it has been identified by past authors. The southern plant, true *H. racemosa* Lam., based upon material from French Guiana, is a coarser plant, with larger, broader leaves and larger flowers. Its sepals are ascending and pallid with a dense indument on their inner surface. In our Central American plant they are reflexed and sparsely hairy and green

on the inner surface. (Fl. C. Z. p. 188, sub *H. americana*). *Johnston 226, 1250; Erlanson 58, 116; Harlow 1, 94.*

Licania platypus (Hemsl.) Fritsch SANGRE

A large tree of streamside forest to be found here and there in all parts of the island but in large numbers only in the Pump Ravine and in the valley of the Rio Marino near Red Hill. It appears to favor well-drained terraces in ravines. Individual trees can be seen to best advantage in Pump Ravine where a goodly number of fine specimens have been left standing on the alluvial terrace in the clearing about the Pumps. Also readily accessible are some trees near Main Road about a hundred yards north of the Goat Barn. The tree usually grows 15–25 m. tall but may approach 30 m. in height. The trunk is commonly more or less buttressed but is rather variable in this respect. The buttressing may be ill defined or, as is not uncommon, in the form of thick planks, 3–6 dm. wide at the base, confined to the lower meter of the trunk. Trees with conspicuous buttressing are not rare. A tree near the Pumps which is nearly 30 m. tall with its first branch about 15 m. above the ground has buttresses 2–9 dm. wide at the base and extending at a steep angle 2–3.5 m. up the trunk. Above the buttressing the trunk is 12 dm. thick. Another near-by tree only a little less tall has buttresses nearly as wide but extending upwards only 2.5 m. Its trunk above the buttressing is 9–10 dm. thick. As a general rule the buttresses of this species have a steeply ascending, straight outer edge. Many of them are characteristically roughened by crowded, elongate, usually curving, thick-lipped lenticels, which in form and crowding are very suggestive of the less coarse ones found on the bark of *Pera*.

The leathery leaves are very elongate, commonly 1.5–2.5 dm. long, about 5 cm. broad, and have nearly parallel margins. The new leaves as they increase in size are a beautiful crimson and tend to hang vertically from the branch that bears them. For a period of several weeks during the first half of the dry season as the foliage is renewed, the tree colors with crimson the streamside forests on the island. At the proper season large numbers of them, magnificent and very conspicuous because of their massed coloration, can be seen below Red Hill Bridge and in Pump Ravine. In 1945 the display of crimson was at its height the first of April, but in 1946 it occurred the last of January. The white flowers are borne in dense spikes about 10 cm. long which are conspicuous on the tree in late February and early March. The large globose-obovoid, brown fruit, said to become 1–2 dm. long and to have a juicy sweet yellow edible pulp, was not found on the island. The species ranges from Mexico to Panama and Colombia. (Fl. C. Z. p. 188). *Johnston 659.*

POTENTILLA NORVEGICA L.

Scattered vigorous plants of this northern species were found about the Goat Barn in January 1946. Several of them had flowered and were maturing seeds. The species was probably introduced from the United States in unclean hay. *Johnston 1242.*

CONNARACEAE

Cnestidium rufescens Planch.

A woody vine that is common in forests and thickets in all parts of the island. It is readily recognized by its odd-pinnate leaves, composed usually of seven pointed, oblong or oblance-oblong leaflets 4–10 cm. long, which are green above and brown and conspicuously veined beneath. The twigs, inflorescence, fruit and lower leaf surfaces are velvety with reddish brown hairs. The means by which this vine climbs was observed in mid-January 1946. At that time the plants, vegetating vigorously, were sending out slender, nearly naked, whiplike shoots 8–12 dm. long. Behaving like tendrils, these shoots twined about any support they touched and then proceeded to develop leaves and axillary shoots. The small white flowers are borne in loose panicles 1–1.5 dm. long. The brown fruit is obliquely ellipsoidal, 8–12 mm. long, and splits down one side at maturity to expose a black seed which has a small scarlet aril embracing its lower end. The species is found in Cuba and from Mexico to Panama and Colombia. (Fl. C. Z. p. 189). *Johnston 139, 227, 413, 1379; Erlanson 112, 560; Harlow 12, 99.*

Connarus panamensis Gris.

One of the most common and generally distributed of the woody vines on the island, abounding in both forests and thickets. It is a coarse, woody, scrambling climber with glabrous, dark green, odd-pinnate leaves composed of three stiff, slenderly pointed leaflets, usually 10–15 cm. long. The plant flowers and fruits several times a year. Its small white fragrant flowers are borne in loose terminal panicles 2–3 dm. long, which are brown, velvety and conspicuous on the plant because of their contrasting color. The asymmetric, glabrous, stalked pods, about 15 mm. long, are red or vermilion at maturity. They are produced in abundance, forming large, heavy, gaily colored clusters that are very decorative on the forest margins. The pod eventually opens down one edge to free the contained seed. This latter is bean-like, black and shiny, and bears a white saddle-like aril below the middle on one side.

The plant is a very adaptable one and is successful in a variety of different situations. In thickets it may become almost self-supporting, the numerous much-branched stems, 2.5–5 cm. thick, supporting a bushy growth as much as 3 m. tall. In many forests, even those with dense canopy, young plants of this species, with slender, scarcely branched, stiffly erect stems, 2–3 m. tall and 1.5–2 cm. thick at the base, are common and make up part of the shrubby understory in the forest shade. The plant apparently grows erect and elongates slowly inside the forest until it reaches some overhanging branch or other support, along which it can scramble on up towards the sunlight on top of the forest canopy. It is the only common woody plant on the island that can begin growth in the shade of dense, undisturbed forest and eventually reach the canopy. The plant has no specialized devices for climbing, but by simple scrambling, growing upwards through supporting vegetation, and locking itself to its support by frequent branching, it climbs high in trees. It is so well affixed to its support that, on isolated trees and along forest margins, its branches frequently project out horizontally from the mass of vegetation for a meter or more. It is very common in the canopy of most forests. Its stems, hanging from the treetops and going through an

endless variety of contortions in the air and on the ground, are probably the most common of the bizarre vine-stems found on the island. The stems may become as much as 13 cm. thick, but are usually 5 cm. or less in diameter. They have a brownish bark. If the stems are scraped or cut by a machete, the bark inside is revealed to be mahogany or dark crimson in color.

The species is found from Costa Rica to northern Colombia. (Fl. C. Z. p. 189). *Johnston 57, 236, 271, 1244; Erlanson 85; Harlow 31, 32.*

Rourea glabra HBK.

A woody vine, climbing high in trees, which was observed in a few places in forests not far from the coast of the island. It grows at the head of Bodega Bay, on Punta del Cabo, along the Navy Cove Road, near South Beach, near East Harbor, and in eastern portions of Area 8B. The station in 8B is over a half-mile from the nearest coast; the other stations are within sight of the ocean or are at most a quarter-mile from the sea. It is a glabrous plant with odd-pinnate leaves composed of 3–5 pointed leaflets 4–12 cm. long and 2–5 cm. broad. The largest main stem seen was 5 cm. in diameter. The vine uses the scrambling technique in climbing, but supplements this by the use of specialized twigs. The tips of some vegetative shoots wrap themselves about a branch, usually in a half hitch, then, ceasing elongation, but increasing in thickness and hardness, function primarily as a device which ties the plant permanently to its support. The small white or yellowish flowers are borne in a very loose panicle 5–10 cm. long. The principal period of flowering occurs late in February. The fruit, usually 15 mm. long and 5 mm. in diameter, is glabrous and turns scarlet at maturity. It eventually opens down one side to free the shiny black seed, 1–1.2 cm. long, that has an orange aril embracing its lower end. This seed is said to be very poisonous.

The species ranges from Mexico and the West Indies south to Brazil. (Fl. C. Z. p. 189). *Johnston 485, 704, 1359; Erlanson 525.*

LEGUMINOSAE

Mimosoideae

Acacia tenuifolia (L.) Willd.

A slender-stemmed, very thorny shrub scrambling abundantly in thickets on the slope behind the mangrove swamp at Long Beach and in thickets near the coast at the mouth of the stream which drains Area 11B. It was not seen elsewhere on the island. The stems are armed with abundant stout, recurved thorns 1–2 mm. long. The bipinnate leaves, with extremely numerous tiny leaflets, have an elongate blade 13–18 cm. long and 4–7 cm. broad. There are 25–35 pairs of pinnae, each with 50–60 pairs of crowded linear leaflets 2.5–4 mm. long. The thorny rhachis of the leaf is 15–23 cm. long. Neither flowers nor fruit of the island plant has been seen. I have seen the plant in all months from the end of December until May, and Erlanson kept it under observation until mid-August, without either of us finding it in flower or fruit. It perhaps reproduces at the end of the rainy season in late November or early December. During the first half of January 1946 it was in a period of great vegetative activity, growing new leaves and sending out many rapidly elongating thorny shoots.

The species is widely distributed in tropical America. The sterile material of the island plant compares well with authentic material of the species. The identification is reasonably certain. *Johnston 799, 1020.*

Entada Gigas (L.) Faw. & Rendle

A large vine draping profusely thickets and woods along the coast, particularly those at the head of sandy beaches and on headlands. Its leaves are bipinnate. The leaf rhachis below its middle bears 2 pairs of pinnae, each with 6–10, usually 8 leaflets, and beyond the middle is naked with a forked apex functioning as a tendril. This tendril part of the leaf is conspicuous on vigorous new shoots and is very effective in tying them to their support. On many of the old leaves it is either broken off or deciduous. The leaflets are obliquely elliptic, 2.5–5 cm. long, 1–2 cm. broad, bright green above and paler beneath. The slender, very elongate leafy stems are usually less than 4 mm. thick and normal in appearance. The larger branches, those 1–8 cm. thick, have orange-brown bark and are unusual in appearance and structure. They do not grow straight, but in a spiral, forming a helix 5–15 cm. in diameter that reverses itself every 1–4 dm. In most kinds of plants the twig grows in girth by a symmetrical increase in diameter. In this *Entada,* however, the new woody tissue develops only on one side of the original leafy twig and soon surpasses in girth the original twig to which it adheres. The hard ridge on the spiral stems of this species—one of its distinctive features—is this original twig, now completely subordinated to the new mass of the woody tissue which it mothered. The main stems are usually elliptic in cross-section and can become very large. Near the road to Observer Beach, along which the plant grows luxuriantly, I measured the trunks of several large individuals. One had a trunk 28–36 cm. thick and another 26–31 cm. Trunks up to 9–12 cm. thick are not rare. These massive stems, unbranched for 3–10 m., may soar directly aloft or trail along the forest floor before ascending at a low angle towards the canopy. They supply very large plants. I cut one stem 9–12 cm. thick and later found that I had killed most of the smothering drapery of vines on a large *Manilkara* nearly 25 m. tall, as well as that on a large area of high thicket near by.

The small yellowish flowers are crowded in a dense elongate spike 15–20 cm. long and 10–15 mm. thick, in which the stamens are the most conspicuous organ. The stamens are at first ochroleucous, becoming butter yellow at anthesis and finally turning brown as they shrivel. The spike is unusual in attachment, being borne on the stem 5 mm. or more above the leaf axil and separated from it by 2–3 minute tufts of brownish hair which appear to be interposed undeveloped, supernumerary axillary buds.

The great pods (PLATE 7), commonly a meter long and 9–12 cm. broad, are the largest fruits produced by the local flora. They are irregular in form and contorted frequently into a single or double sigmoid curve. The sides of the curved pod are in constantly shifting planes. Not uncommonly they are narrowed in one or more places to a few centimeters in width, where, by a sharp twist, adjoining sections of the pod are brought into planes at right angles to each other. The pod remains green until mature and then turns brown as it dries out preparatory to breaking up and freeing the seeds. It is segmented in construction. In breaking up, the sections of tough chartaceous prominently veined epicarp over each seed cavity are shed first, either

individually or several together, to expose the envelope of endocarpial tissue in which each seed is borne. These endocarpial envelopes may eventually free themselves from the skeleton of the pod and drop with the seed still enclosed or may remain attached for a time and liberate the seed before falling themselves. Since the pods normally break up while still attached to the mother plant, one rarely finds more than fragments of them on the forest floor, even though the plants producing them may be fruiting in the canopy above. Camouflaged in green and dangling close under cover of the leafy drapery of the vine, these great pods are seldom seen except by those who look for them.

The hard, thick, lustrous dark brown seeds, 4–5 cm. broad, are produced 5–15 in each pod. They are the large mahogany-colored beans, about the size and shape of a pocket watch, which are frequently found washed up on the beaches of the island, PLATE 8, FIG. 1. Their seed-coat is very tough and hard and impervious to water, permitting them to float for long periods and great distances in the sea, unharmed by the salt water. Buried after excessive weathering or subjected to long periods of slow decay in the soil, such seeds may eventually become permeable and proceed to germinate after many years, decades even. It is reported, however, that the hardening process in the seed-coats of this species is sometimes prolonged beyond the time when the seed first becomes capable of germination. In such cases, if the seeds are planted at the right time they are relatively permeable to water and germinate rather promptly. This is a development favorable for the species, since it allows some seeds to germinate without delay, thus allowing the species to spread promptly to areas suddenly opened to it for colonization. Termites may also serve the plant to this end. On Punta del Cabo I found termites in many of the pods that had turned brown and were drying out preparatory to falling apart and freeing the seeds. The insects were present in large numbers in the pods, feeding chiefly on the endocarp, but had scarred the seeds, which apparently had been gnawed before their coats had hardened. Some of these seeds had their coats deeply etched by termite work. Their coats damaged, they could be expected to absorb water and germinate much sooner than undamaged seeds.

The species is restricted to Central America, the northern West Indies, northwestern South America and tropical West Africa. It is found chiefly at low altitudes and especially near the coast. It is a well-marked species and readily distinguished from the vines of the Pacific Islands, southern Asia, and eastern Africa, with which botanists have improperly identified it, usually under the name *Entada scandens* (L.) Benth.

The name *Entada Gigas* (L.) Fawcett & Rendle is derived from *Mimosa Gigas* [Sandmark] L., 1759, which was based upon a description of a Jamaican plant published by Patrick Browne in 1756. The only other name properly to be applied to the American plant is *E. gigalobium* DC., 1825, a binomial also based on Browne's Jamaica plant.

The name *Entada scandens*, which has been much used for our American vine, is based upon *Mimosa scandens* L., 1763, which is an aggregate species best restricted to the plant from Amboina described in detail and illustrated in the work of Rumphius cited by Linnaeus. The Linnaean diagnosis is ambiguous except for the phrase "foliolis bijugis," which refers to a distinctive character of the Amboina vine treated by Rumphius. The oldest name for

that plant, however, is *Lens phaseoloides* [Stickman] L., 1754, a binomial based exclusively upon the Rumphian plate and description. In its strict sense, therefore, the name *Entada scandens* (L.) Benth. falls as a later synonym of *Entada phaseoloides* (L.) Merrill. A good illustration of true *E. phaseoloides* was published by Scheffer when he described the synonymous *E. Rumphii,* Natuurk. Tijdschr. Nederl. Ind. **32:** 90, t. 17 & 18B (1872). The species is distinguished by having very broad leaflets and by having only four of them on each pinna. It ranges from Africa to Polynesia and extends north in southeastern Asia to China. Most of its range, however, is south of the equator. Two principal species have been confused with *E. phaseoloides* in the Old World. One is *Entada Pursaetha* DC., 1825, of India and possibly East Africa, which was elaborately illustrated by Rheede, Hort. Malabar. **8:** 59, t. 32–34 (1688), and described in detail by Roxburgh, Fl. Ind. **2:** 554 (1832). The other species is **Entada Gogo** (Blanco), comb. nov. This latter was originally described from the Philippines as *Mimosa Gogo* Blanco, and ranges from Java north to China, Formosa and the Marianas. It has been well illustrated by Scheffer, l. c. tab. 16 & 18A (1872), Brown, Bull. Philippine Bur. Forestry **22**[3]**:** 54, fig. 3 (1921), Safford, Contr. U. S. Nat. Herb. **9:** tab. 56 (1905), and Kanehira, Formosan Trees, fig. 194 (1917). Both these species have smaller, more numerous leaflets than true *E. phaseoloides.* The Indian *E. Pursaetha* can be separated from the more easterly *E. Gogo* by its rounded leaflets and by its habit of bearing its hairy spikes in paniculate axillary clusters.

The American *E. Gigas* has a geographical range lying between the areas occupied by true *E. phaseoloides.* The latter species ranges east in the Pacific to Fiji and west in Africa to the Belgian Congo, cf. deWilldeman, Pl. Bequaert. **3:** 80, t. 1–3 (1925) and Etudes Fl. Bas- et Moyen Congo 257, t. 75 (1908). The American plant, however, most closely resembles *E. Gogo* of the western Pacific, but is quickly distinguished from it, as well as from other Old World species, by its very different pods and by its habit of bearing its spikes conspicuously above the leaf axil and separated from it by several undeveloped axillary buds. No satisfactory illustrations of our American vine have been published. One by Tussac, Fl. Antil. **3:** 79, t. 21 (1824) is poor, except for showing the texture of the pod. The best illustration is by Fawcett & Rendle, Fl. Jamaica **4**[2]**:** 125, fig. 38 (1920). It shows the flowers, inflorescence and vegetative structures well, but the pod figured is almost certainly that of some species of the Old World.

The pods of *E. Gigas* are conspicuously less woody and very much less symmetrical than those of its Old World relatives. The replum is only 3–5 mm. thick, much less conspicuous, and never so rigid and woody as in other species. The texture of the endocarp and exocarp is thick chartaceous, prominently veined and somewhat flexible, and not hard and rigid. The pedicel is not joined to a thick, almost exactly basal, angulate end of the pod as in other species. The base of the pod is rounded and the pedicel attachment is suprabasal and marginal. The replum along that margin of the pod to which the pedicel is attached (morphologically the lower) is noticeably thicker than that on the other margin. The pod has undulate margins, but the incurving of the replum, which narrows the pods between its segments, is irregular and decidedly stronger along the upper than along the lower margin. Indeed, so strong is the incurving along the upper margin that at one or more places

it frequently cuts down the width of the pod to only a few centimeters. In large pods, prevailingly a decimeter wide and about one meter long, one or more of such constrictions in breadth are not at all uncommon. They contribute to the distinctive contortions of the pod, for there is usually a sharp twist at these constrictions which causes adjoining portions of the pod to stand in planes at right angles to one another. The pods of *E. Gigas* have very much less rigidity than those of its relatives. The pods of the Old World species support their own weight when held at one end, either horizontally or vertically. Those of the American species would bend, break, and collapse if similarly treated. The characters which distinguish the pods of the American species from its Old World relatives involve many gross and minute details in form and structure and are obvious, numerous, and decisive. With pods so outstanding there can be no doubt as to the specific distinctness of the American plant.

Seeds of *Entada Gigas* are superficially similar to those produced by its Old World relatives, but appear to differ in proportions. Viewed laterally, with the hilum end uppermost, the seeds of *E. Gigas* are broader than high, rather than higher than broad. Good photographs of typical seeds of the American species have been published by Guppy in the frontispiece, fig. 1, to his book, "Plants, Seeds, and Currents" (1917), and also by Colgan, Proc. R. Irish Acad. **35**[B]**:** 48, t. 10, fig. 1–3 (1919). The seeds of the Old World species may be nearly circular, but they are more commonly higher than broad. Such seeds, picked up on the beaches of South Africa, are illustrated by Muir, Union So. Africa, Dept. Agric. & Forestry, Bot. Survey Mem. **16:** 16, t. 1, f. 1–3 (1937). DeWilldeman, Pl. Bequaert. **3:** 80, t. 1–3 (1925), has good photographs of similar seeds from the Belgian Congo. The good drawings of Rheede and of Scheffer, previously cited, show seeds of the same type. I have seen numerous *Entada* seeds picked up on beaches at a variety of places in the West Indies and Florida and have seen numerous seeds associated with herbarium material from American localities. All these are broad. Narrow or at times nearly circular seeds are those represented in the small amount of beach drift and in the herbarium material that has been available to me from the Old World. There is good reason therefore for accepting the broad type of seed as distinctly American and produced solely by *E. Gigas*. The narrow type of the Old World are produced by *E. phaseoloides*, *E. Pursaetha*, *E. Gogo*, and perhaps some other Old World members of the genus. The seeds of *E. Gigas*, the largest of the sea beans, have been picked up on the beaches of Central America, the Greater Antilles, the Bahamas, Florida, and on the coast of Europe. Guppy, l. c. 117–120, reports them from beaches on sides of the isthmus of Panama and from Ecuador. I found them frequently on the beaches of San Jose. (Fl. C. Z. p. 192, sub *E. scandens*). *Johnston 600, 983; Erlanson 15, 82.*

Entada polystachia (L.) DC.

A high climbing woody vine growing near the coast, especially about the margins of mangrove swamps. Its broad bipinnate leaves have usually 3 (2–4) pinnae, each bearing 6–9 pairs of oblong, obtuse leaflets 2–4 cm. long and 8–18 mm. wide. There are no tendrils. The rhachis of the pinnae, in addition to bearing the leaflets, frequently wraps its basal portion in a half hitch about twigs and thus serves in tying the shoot to its support. The plant is

a very much less vigorous one than its relative *E. Gigas*. It forms a rather loose growth and, unlike its relative, rarely appears to handicap much the trees supporting it. The largest stem seen measured only 7 cm. in diameter. This had normal wood development. The flowers, malodorous, reddish brown, and produced in clusters of slender spikes, were not seen on the island. They probably appear in late November or early December, since maturing pods were found abundantly at the end of December 1945. The flat, rather oblong pods are 15–30 cm. long and 4–8 cm. wide, are borne in clusters in treetops, and are rather conspicuous. In January 1946 there was a good display of them in the mangroves just upstream from the Mata Puerco Bridge. The pods break up while still attached to the plant, first shedding their exocarp and later transverse sections of the straw-colored endocarp. These sections of the endocarp contain a single seed and are roughly oblong in shape, usually 1–3 cm. broad, and light in weight. When detached they spin and fall slowly, and can be carried some distance in a wind. The small brown seeds are much flattened, nearly circular in outline, and commonly 10–13 mm. in diameter. By mid-February 1946 the plants on San Jose had completed fruiting and had dropped most of their leaves. They are leafless during most of the dry season. The species ranges from Mexico and Haiti to northern South America. (Fl. C. Z. p. 192). *Johnston 857, 933, 982.*

Inga spuria H. & B. GUAVO

A tree growing along streams, especially in gravel, usually in sunny openings in streamside forests. It is bushy and only 2–3 m. tall or a small tree up to 8 m. high. Occasionally it may become a good-sized tree. One noted in Area 11D grew over 20 m. tall and had a trunk 3 dm. thick. The species was noted in all parts of the island but was nowhere common. The largest concentration of trees seen was along the Rio Marino near Red Hill. The plant is easily recognized by its pubescent, even-pinnate leaves. These have a rhachis which is conspicuously margined between the 5–7 pairs of leaflets and bears small cup-like glands about 1 mm. broad along its upper side between the leaflets of each pair. The largest leaflets, those terminal on the rhachis, are 6–13 cm. long. The flowers, appearing in February, are borne in stout racemes and consist chiefly of conspicuous tufts of yellowish stamens about 2 cm. long. The fruit is a ribbed, elongate pod 1–3 dm. long and 1–2 cm. thick, containing numerous seeds surrounded by an edible sweet white pulp. They are matured late in the dry season. The species ranges from Mexico to Panama, Venezuela and Trinidad. (Fl. C. Z. p. 190, plate 30). *Johnston 632, 698, 1277; Andersson.*

MIMOSA PUDICA L. SENSITIVE PLANT

A low, prickly, herbaceous plant with bipinnate leaves that fold up promptly when the plant is roughly disturbed. The leaves have 1–2 pairs of pinnae, each with 15–20 leaflets. The small pink flowers with conspicuous stamens are borne in globular-ellipsoidal heads about 1 cm. long. In October 1944 two plants had become established on the island, one near the Hospital and another near the Engineer Camp. As botanical curiosities they were given protection and known to many of the soldiers on the island. By February 1946 the species had spread in the Headquarters area at Main Camp and also about the Engineer Camp, with a goodly number of well-established but scat-

tered plants to be found at both places. Obviously several additional years will be required before it becomes as common a weed as it usually is about settlements in the Canal Zone. The species is widely distributed in the tropics. (Fl. C. Z. p. 193). *Erlanson 553.*

Mimosa pusilla Benth.

A small slender-stemmed, loosely branched, herbaceous annual, locally abundant among grass on open areas with thin soil at the head of sea cliffs at East Harbor. It has bipinnate leaves with 2–3 pairs of pinnae, each with 6–18 pairs of crowded leaflets 2–5 mm. long. Most plants have the stems and leaves smooth and glabrous. Growing with these, and otherwise inseparable, are plants that have setose leaflets and stems bristly with slender prickles. The small pink flowers with 8 stamens are borne in small heads. The plant comes into flower in November or late October and fruits and dries up by the close of the year. The species, ranging from Guatemala to Panama, is apparently rare. *Johnston 177, 818, 818A.*

Pithecollobium rufescens (Benth.) Pittier

A common forest tree with a dense spreading crown. It is rarely more than 15 m. tall or has a trunk exceeding 35 cm. in diameter. As a bushy tree it is frequently common in high thicket. Its leaves are even-pinnate and made up of 3–5 pairs of leaflets which usually are 5–10 cm. long and inconspicuously pubescent with brown hairs. The minute flowers, borne in dense globose clusters, form balls of pale yellow stamens about 2 cm. in diameter. The distinctive fruit is a somewhat juicy, red, elongate, usually much contorted pod 8–13 cm. long and 1 cm. or less thick, containing black seeds. It begins to mature about the beginning of the rainy season and hangs on the tree for a long period. By October and November the fruits are very numerous and attract much attention. The tree renews its foliage and begins to flower in late March or April. The species is known only from Panama. (Fl. C. Z. p. 196). *Johnston 13, 28, 531, 638, 638A; Erlanson 39, 368; Harlow 88; Andersson.*

Prosopis juliflora (Sw.) DC.

A loosely branched, spreading, thorny, tree 2–5 m. tall which grows sparingly on the dunes at the mouth of the Rio Marino. The stems are armed with pairs of strong straight thorns 1–3 cm. long. The bipinnate leaves are composed of 1–2 pairs of pinnae. There are about 12 pairs of leaflets 1–2 cm. long on each pinna. The flowers are borne in spikes. The fruit is a bean 2 dm. long. The species ranges at low altitudes from southern Mexico and the West Indies south into northwestern South America. (Fl. C. Z. p. 192, sub *P. chilensis*). *Johnston 1261.*

CAESALPINIOIDEAE

Bauhinia Thompsonii, sp. nov. MONKEY LADDER

Frutex alte scandens cirrhifer inermis; ramis majoribus vetustioribus ligulatis undulatis; ramulis minute sericeo-strigosis plus minusve glabrescentibus; foliis coriaceis supra medium vel non rariter usque ad basim bilobatis, supra glaberrimis, subtus juventate minutissime plus minusve sericeo-strigosis mox glabrescentibus, basi cordatis; foliolis 6–15 (saepissime ca. 9–12) cm. longis

2.5–7 (saepe 3–4) cm. latis, apice acutis vel subacuminatis, basi rotundis, subtus evidenter 4-costatis; racemis ad 10 cm. longis densifloribus; alabastro floris ovoideo ad 8 mm. longo ca. 5 mm. crasso obscure 10-costato minutissime strigoso plus minusve ferrugineo basi rotundo apice obtuso nullo modo appendiculato; pedicello 2–5 mm. longo ascendenti; bracteolis ad 1 mm. longis lanceolatis mox deciduis; calyce sub anthesi spathaceo 6–8 mm. alto 10–12 mm. diametro irregulariter brevidentato, dentibus latis mucronulatis; petalis albis heteromorphis, intus glabris, extus pallide sericeo-villulosis vel tomentulosis; petala inferiore majore 2.2 cm. longa, lamina elliptico-oblonga 1.5 cm. longa ad 1 cm. lata e basi palmate 7-nervata, apice obtusa, basi obtusa in unguem conduplicatum ca. 0.5 mm. longum 1.5–2 mm. latum abrupte contracta; petala superiore minore 2 cm. longa conduplicata solum apicem versus plana 2–3 mm. lata; petalis lateralibus 2.2 cm. longis, laminis ellipticis 1.5 cm. longis ca. 8 mm. latis in unguem conduplicatum ca. 0.5 mm. longum abrupte contractis; staminibus 10 glabris 8–10 mm. longis; ovario dense sericeo-strigoso 4–7-ovulato; leguminibus minute inconspicueque sericeo-strigosis vel subglabris 8–12 cm. longis 2–2.5 cm. altis valde lateraliterque compressis 2–3 mm. crassis, latere subplanis, apice obtusis et rostratis (rostro lineari curvato ad 1 mm. crasso 7–10 mm. longo), basi acutis in stipitem 6–8 mm. longum contractis.

TYPE: *Johnston 539*, San Jose Island, north end of Air Strip, vine on thicket and trees.

A woody vine common in forests and thickets on the northern half of San Jose but rare and local on the southern half of the island. It is readily recognized by its distinctive stems and leaves, PLATES 6 and 16.

The leaf-bearing stems are circular in cross-section and normal in appearance. Such stems, however, after reaching about 5 mm. in diameter proceed to increase in size in an anomalous manner. There is no longer a symmetrical increase in girth, but rather an excessive development of new woody tissue on two opposing sides. The result is a stem of ribbon-like form. Such stems when 2–3 cm. broad commonly maintain the thickness of the original twig, but, subsequently, gradually also thicken and eventually may become as much as 2 dm. wide and nearly 1 dm. in thickness. When only a few centimeters wide they assume a characteristic undulate form, and in their regular curving back and forth become concave on the inside and convex on the back of each curve. Branches arise from the convex portions of these ribbony stems, but are usually few and commonly represented only by hard deflexed spurs 5–15 mm. long, the persisting, somewhat enlarged bases of former twigs. The curving back and forth of the stem and these deflexed spurs serve admirably in affixing the stem and giving it numerous points of support, as it grows upward through other vines and branches of trees. The undulations and the alternations of concave and convex surfaces that characterize the younger stems become progressively less marked as the stem increases in thickness and width, and in massive old stems they persist only as a series of coarse depressions decorating the sides of these great ribbons of wood.

Occasional stems do not follow the pattern of development described. A not uncommon variation results when, for some reason, lateral growth develops, not equally on opposing sides of a twig, but on only one side of it. Under such circumstances the stems develop into spiral, not undulating, ribbons of wood. They form a series of helicoid coils, 1–3 dm. in diameter, which re-

verse their direction of ascent at frequent intervals. A suspended stem of this sort, hanging like a loosely coiled giant spring or a monstrous wooden curl, is one of the most bizarre forms of growth in the forest. These remarkable coils are evidently associated with unilateral stem growth. The stems of *Entada Gigas*, though round rather than flat, also grow unilaterally and become coiled. The direction of its spirals is reversed at intervals just as in the unilateral stem of this *Bauhinia*. Forces set up by unilateral growth appear to throw the stem into a spiral. Perhaps the balancing of these forces by lateral growth on opposing sides of the stem, as in the normal stem of *Bauhinia*, may be the cause of the undulations and alternation of concave and convex surfaces that characterize the latter.

In thickets the stems rarely reach large size. They are usually at most a few centimeters wide, and many of them show only moderate amounts of lateral growth. Frequently they originate from a stout trunk hidden in the brush, which may become a meter tall and a decimeter thick. In the forests, however, the stems ascending to the canopy are well developed woody ribbons that may become 1–2 dm. broad. Many fine examples of these so-called "Monkey Ladders" are to be seen in the Marino Forest along the East Loop. Many spring from the ground without much basal thickening. Occasionally, however, a number of them arise from a gnarled, contorted, trunk-like base that may be as much as 3–4 dm. thick and may lounge and writhe along the forest floor for a distance of 3–4 m. before giving off all its branches.

The leaf of this vine, suggesting in form the footprints of a cow, appears to be cleft down the center line and partially or completely divided into pointed, lateral halves, usually 9–12 cm. long, which are straight on their contiguous margins and rounded on their outer ones. Actually, however, the leaf is a compound one, composed of a single pair of leaflets more or less grown together along their adjoining margins. At maturity they are green and glabrous, but when young may be silvery or rarely golden on the under side from a satiny covering of abundant minute, closely appressed silky hairs.

The vine has its period of vigorous vegetative growth in February. It comes into general flower in early March and is maturing the last of its fruit in April. The vigorous slender shoots bear watch-spring tendrils which serve to tie the shoot to its support. They are grappling devices, and if hooked about a supporting twig, by thickening and losing their springiness, they become permanently affixed to it. The white flowers, about 2 cm. long, are borne in stiff dense racemes about 1 dm. long. The flat pods, 8–12 cm. long and 2–2.5 cm. broad, are elastically dehiscent.

The species is known only from San Jose Island. It is related to *B. excisa* Griseb. of Trinidad and Guadaloupe, but differs in its larger flowers, elongate petals, and lighter colored, more appressed, and finer pubescence. From *B. sericella* Standl., its other close relative, it differs in its large, rarely bifoliolate leaves, larger pods and flowers, shorter and stouter pedicels, and denser inflorescence. The species is named for my good friend Professor Thomas G. Thompson, Director of the Oceanographic Laboratories, University of Washington, who, then Colonel, was Technical Director of the San Jose Project during my second visit to the island. *Johnston 211, 374, 539, 551, 772, 913; Erlanson 21, 69, 109; Campbell 4; Harlow 89; Andersson.*

Cassia diphylla L.

A slender annual herb 5–12 dm. tall which is locally common on grassy open places with thin soil above the sea cliffs at East Harbor. It starts flowering in October and is dead by January. The leaves have large stipules and a single pair of broad asymmetrical rounded leaflets 2–3 cm. long. The small yellow flowers are borne in the leaf axils. The pod, 2–4 cm. long and 5 mm. wide, is flat and elastically dehiscent. The species is found in Central America, the West Indies, the Guianas and Brazil. (Fl. C. Z. p. 198). *Johnston 183; Harlow 74.*

Cassia fruticosa L.

Usually a shrubby plant of forest borders, with a few erect, sparingly branched stems 2–3 m. high, or rarely a weak tree of thickets and open forest that, with some support, may become as much as 4–8 m. tall and develop a trunk 4–8 cm. thick. It is found scattered on all parts of the island and seems to have increased in abundance at forest borders along roads. The pinnate leaves bear two pairs of broad leaflets 8–13 cm. long. The yellow flowers, 2–2.5 cm. broad, are borne in handsome globular clusters which hang down from the recurved tip of the slender leafy branches. The most general and profuse flowering appears to be in December and January. The pods, hanging in clusters from the tip of the stems, are straight, nearly cylindrical, 1–2 dm. long, 8–10 mm. thick, and indehiscent. They are matured in the dry season. The species ranges in Central America, the West Indies and northern South America. (Fl. C. Z. p. 199, sub *C. bacillaris*). *Johnston 335, 362, 576; Erlanson 42, 194.*

Cassia stenocarpa Vogel

A slender annual growing in thin soil on the top of exposed rocks along the shore of Hicaco Island. The plant is simple or sparsely branched, 3–12 dm. tall, and bears its small yellow flowers in the leaf axils. The even-pinnate leaves, 3–5 cm. long, have about 20 pairs of small bristle-tipped, ciliate-margined, oblong leaflets. The pods, 3–4 cm. long and 4 mm. wide, are flat and elastically dehiscent. The species is widely distributed in tropical America. (Fl. C. Z. p. 199). *Johnston 928.*

Caesalpinia Bonduc (L.) Roxb.

A thorny, clambering coastal shrub usually growing in thickets along sandy beaches. It grows at Orangetree Beach, Long Beach, Main Beach, Mango Beach and Playa Grande, but is common only at the last mentioned place. At the north end of Playa Grande it dominates in a belt along the swamp, forms a formidable thorny thicket 2.5 m. high, and clambers to the top of large manchineels growing near by. The largest stems seen were 6 cm. in diameter and had a core of white pith 6 mm. thick. The bipinnate leaves are usually 3–4 dm. long and 2–3 dm. broad. The thorny rhachis usually bears 6 pinnules, each with 6–8 pairs of acute leaflets 3–5 cm. long and 1.5–2.5 cm. broad. The unattractive flowers are borne in a raceme. The distinctive asymmetric, biconvex pods, 5–6 cm. long, 4–4.5 cm. high, and 1.5 cm. thick, mature 1–2 seeds and are covered with stiff prickles 4–8 mm. long. The ovoid or subglobular seeds, commonly 1.7–2 cm. long, are smooth, slate gray, slightly flattened laterally, and have a small dark scar on the end. These

seeds (PLATE 8, FIG. 8), frequently known as "Nickernuts," are one of the sea-beans frequently found washed up on tropical beaches. They are common in the beach drift on San Jose. The species is widely distributed along coasts in the tropics. (Fl. C. Z. p. 198, sub *C. crista*). *Johnston 722; Erlanson 430.*

Caesalpinia eriostachys Benth.

A tree 3–18 m. tall, characteristic of the deciduous forest developing on thin soils along the eastern coast of the island. It is most common on the eastern peninsula and there extends inland in suitable places to the western boundary of Area 8C. The bipinnate leaves are fern-like and usually 15 cm. long and 10 cm. broad. The rhachis, usually glandular and somewhat hairy, bears 5–10 pairs of pinnae, each usually with 15–25 crowded, alternating, asymmetric obtuse leaflets 5–10 mm. long. During the dry season the tree thins out its foliage, and some individuals become almost leafless. The yellow flowers are borne in open racemes 1–1.5 dm. long. The pods, 10–15 cm. long and elastically dehiscent, are matured in the first half of the dry season. The species is found in Cuba and from Mexico to Panama. (Fl. C. Z. p. 193). *Johnston 399, 565; Erlanson 462.*

Mora oleifera (Triana) Ducke ALCORNOQUE

A large tree, 10–22 m. tall, growing in coastal swamps and at river mouths where the base of its trunk, as well as its roots, are periodically inundated by mixtures of fresh and salt water. A few trees were noted at the mouth of the stream draining Area 11B, at the stream mouth at the end of Canyon Road, at the head of Navy Cove, at South Beach, and near the mouth of the Rio Marino, but good colonies of the species were found only at Main Beach and along the Rio Marino about half way between Red Hill and the coast. At Main Beach the tree averages about 20 m. tall, has a trunk 4–12 dm. thick, breast-high, and clear of branches for 6–8 m. Some are unbuttressed, but others have thick buttresses projecting as much as a meter and running up the trunk 6–24 dm. The fine grove below Red Hill is in a sheltered valley on the silty bed of the Marino at the upper limit of tidal influence. The trees average 18–22 m. tall, are very widely spreading, and have short, heavy, conspicuously buttressed trunks. The trunks have a brownish bark that flakes off in plates as in the Plane Tree and, like that tree, are somewhat piebald because of it. At this locality the roots frequently arise from the silt and return to it, forming exposed loops 5–10 cm. high, which possibly may serve as pneumatophores.

The leaves are even-pinnate and composed of two pairs of leaflets 15 cm. long. They are renewed late in October. The old foliage turns yellowish before falling, and for a week or so the trees are very conspicuous because of their coloration. The flowers, which are white, small, and borne in dense spikes 1 cm. thick and 5–15 cm. long, have not been collected on the island. The huge pod, matured towards the close of the rainy season, becomes 12–25 cm. long, 10–12 cm. broad, and about 8 cm. thick. It matures one or two huge thick seeds 8–10 cm. broad which are among the largest seeds known, apparently being exceeded, in fact, only by seeds of a few species of palm. A good illustration of this seed is to be found in Standley's Flora of the Panama Canal Zone, plate 35. When they fall to the ground they germinate

promptly. The two thick cotyledons which make up most of the seed spread disrupt the thin brown seed coat, and finally diverge at an angle of almost 90 degrees. Their exposed inner faces are pink and somewhat corrugated. As the spread cotyledons lie on the shaded floor of the swamp they suggest the gaping mouth of some strange animal. Some of these germinating seeds manage to strike root, but most of them are washed away by the tide, and in November many can be found washed up on the beaches. The tree is undoubtedly spread by ocean currents.

The species is found along the Pacific Coast from Costa Rica to western Colombia. Most authors have treated this species under the names *Dimorphandra megistosperma* Pittier (1915) or *Mora megistosperma* (Pittier) Britt. & Rose. The oldest name for the plants is *Dimorphandra oleifera* Triana, usually cited as a *nomen nudum* published by Hemsley, Biol. Cent. Am. Bot. **1:** 342 (1880), since Hemsley's later description of the species, Bot. Voy. Challenger **3:** 301 (1885), has been overlooked, as is not surprising, buried as it is in a footnote in a discussion of drift seeds picked up on the coast of Jamaica. (Fl. C. Z. p. 203, plate 35, sub *Dimorphandra megistosperma*). *Johnston 5.*

PRIORIA COPAIFERA Griseb. CATIVO

During the first half of the dry season the distinctive pods of this tree (PLATE 12, FIG. 2) are washed up on the beaches of San Jose in considerable numbers. I found some that appeared to have viable seeds. The tree producing them, although searched for, was not found on the island and probably does not grow there, though very likely it may be present on some of the adjacent islands. The species ranges from Nicaragua to Colombia. (Fl. C. Z. p. 202, plate 34).

PAPILIONATAE

Aeschynomene americana L.

A slender-stemmed annual, growing prostrate on an exposed headland on Hicaco Island, and erect, 6–24 dm. high, on thin soil above the sea cliffs at East Harbor, apparently native in both places. Acting as an introduced weed, the plant was also found, in December 1945, well established in the lawn about the chapel at Main Camp, where it grew 6–24 dm. tall. The pinnate leaves, 2–5 cm. long, have numerous slender, crowded leaflets. The small flowers are dull yellow, orange, or white flushed with pink. The jointed pods are 1.5–3 cm. long. The species, a variable one, is widely distributed in the American tropics. (Fl. C. Z. p. 210). *Johnston 832, 937, 1201.*

Aeschynomene brasiliana (Poir.) DC.

A low, slender-stemmed plant with many viscid, pilose stems, sprawling on open ground or clambering over low vegetation. It is common in disturbed places in the grassland on Bald Hill, along the road at Max Point, and on thin soil back of the sea cliffs at East Harbor. The pinnate leaves, 2 cm. long, have 10–12 crowded, oblong leaflets. The small flowers are yellow and the jointed pods are about 1 cm. long. The species is widely distributed in the American tropics. (Fl. C. Z. p. 210). *Johnston 880.*

AESCHYNOMENE SENSITIVA SW.

A single, slender-stemmed, very loosely and widely branched shrub, over 2 m. tall, was found at Main Camp, growing on the terrace at the south end of the Ice Plant. The pinnate leaves, 4–8 cm. long, have about 20 pairs of small oblong leaflets which close when the plant is roughly handled. The fruit is a jointed pod 3–5 cm. long. The plant, first noted in January 1946, is almost certainly introduced. The species is widely distributed in the American tropics and is usually found in swampy places. (Fl. C. Z. p. 210). *Johnston 910.*

ARACHIS HYPOGAEA L. PEANUT

Flowering plants, accidentally established from discarded unroasted peanuts, were found growing uncultivated near the Navy Station by Erlanson in June 1945. I could find no trace of the plants in 1946. *Erlanson 363.*

ALYSICARPUS VAGINALIS DC.

An introduced weed, well established at the roadside just back of Main Beach in December 1945. It is a prostrate, slender-stemmed herb with simple, elliptic leaves, cordate at the base and 1–1.5 cm. long. The inconspicuous flowers are borne in terminal clusters. The slender jointed pods are 1–2 cm. long. Native of the Old World. *Johnston 858.*

Andira inermis (Wright) DC. CABBAGE BARK

A common tree in forests and high thicket. It usually has a dense crown and grows 10–18 m. tall. Occasional trees may become as much as 22 m. high and develop a trunk reaching 4 dm. in diameter. The odd-pinnate leaves have 9–15 lanceolate leaflets 5–10 cm. long and 1.5–4 cm. broad. They are renewed in January and early February. The pinkish purple, pea-like flowers, about 1 cm. long, are borne on racemose branches of a loose panicle 1–3 cm. long. The standard is usually pink or almost magenta towards the margin, deepening in color and becoming brownish red about the white center. The flowers are produced in late February and early March. The ovoid, green, indehiscent fruit, 2.5–3 cm. long, has thick tough walls, matures a single seed, and ripens late in the dry season.

The species ranges in the West Indies, Mexico, and Central America and south into northern South America. It was first described by William Wright, Phil. Trans. Royal Soc. London **67:** 512, t. 10 (1778), who illustrated it, gave it a Latin description, and discussed its medical properties under the name *Geoffraea jamaicensis inermis*. This is a polynomial, and the name based upon it, *Andira jamaicensis* (Wright) Urban, is accordingly invalid. The first legitimate name for the tree is *Geoffraea inermis*, published by Wright in the London Medical Journal **8:** 256 (1787), where he refers to his early account and again discusses the medical properties of the tree. This is a year earlier than the publication of the same binomial by Swartz, Prodr. 106 (1788). The combination "*Andira inermis*" is usually attributed to Humboldt, Bonpland & Kunth, Nov. Gen. et Sp. **6:** 385 (1824), but they merely suggested that *Geoffraea inermis* belonged to the genus *Andira* and did not make the actual transfer, that first being done by DeCandolle, Prodr. **2:** 475 (1825). The usual citation given for this species, "*Andira inermis* (Sw.) HBK.," is accordingly bibliographically incorrect. (Fl. C. Z. p. 218, plate 38). *Johnston 9, 45, 559, 784, 1362; Erlanson 139, 418.*

Calopogonium mucunoides Desv.

A slender, herbaceous, twining vine which is most abundant in open areas with thin soil. It grows at Max Point and at many places on the eastern peninsula, being extremely common near East Harbor. It also grows in disturbed places in the grassland on Bald Hill and along roads through thickets to the northward. In January 1946 a few plants had appeared in the lawns at Main Camp. The plant starts its growth about the first of October and dies in February. It has bristly stems and hairy compound leaves with three ovate leaflets 3–6 cm. long and 1.5–5 cm. broad. The minute flowers are blue. The oblong, very hairy pods are 2–3 cm. long and 3–4 mm. wide. The species is found in Central America, the West Indies and northern South America. (Fl. C. Z. p. 216, sub *C. brachycarpum*). *Johnston 1026; Harlow 81.*

Canavalia rosea (Sw.) DC.

A coarse herbaceous vine trailing on sandy beaches or clambering on low beach growth. It is particularly common on Long Beach and E. M. Beach. One plant, growing on a broken sandbag, was noted on Bald Hill grassland. The three leaflets of its compound leaves are thickish, elliptic to nearly orbicular, and 6–9 cm. long and 5–7 cm. broad. The pink or lilac pea-like flowers, about 2.5 cm. long, are borne in elongate racemes at the close of the rainy season. The coarse pods, 8–10 cm. long, 2 cm. high, and 1 cm. thick, have a high narrow ridge on both sides about 5 mm. down from the upper margin. These pods mature late in February and are conspicuous for a time on the beaches. The ellipsoidal seeds are about 12 mm. long and have an elongate attachment scar 8 mm. long and 1.5 mm. wide down one side. They are frequently found in the sand and in the drift on the beaches.

The species is widely distributed along beaches in the tropics of both hemispheres. Recent authors have treated the species under the name "*C. maritima* (Aubl.) Thouars." That name, however, is bibliographically false. *Canavalia maritima* Thouars, 1813, was published without any reference to *Dolichos maritima* Aubl., 1775. The agreement in specific epithet is mere coincidence. Aublet's species cannot be transferred to *Canavalia*, since the resulting binomial has been preëmpted by Thouar for what is taxonomically a distinct species, even though it may be a synonymous one. The oldest available name for the plant is *C. rosea* (Sw.) DC. (Fl. C. Z. p. 216, sub *C. maritima*). *Johnston 787; Harlow 98.*

Centrosema pubescens Benth.

A slender, herbaceous twiner growing on bushes at the margin of the forest bordering the grassland on Bald Hill. Also established on the bank about the buildings at the Cross Roads and in the lawns at Main Camp, where it may have been introduced in turf transported to these places from Bald Hill. The compound leaves have three elliptic leaflets 3–8 cm. long and 1.5–3.5 cm. broad. The large and attractive flowers produced at the beginning of the dry season are about 3.5 cm. long and are violet with some white on the large standard. The straight, flattened pods, 10–13 cm. long and 4–5 mm. wide, have an erect, slender beak 1.5 cm. long. The species is widely distributed in the American tropics. (Fl. C. Z. p. 215, sub *Bradburya pubescens*). *Johnston 888, 1010, 1062.*

Clitoria portobellensis Beurling

In thickets a dense, erectly and stiffly branched bushy plant 10–15 dm. high, or, more commonly, a vine with slender, very elongate, brownish twining stems arising from a bushy caudex. In forests it becomes a large woody vine, reaching the treetops and developing main stems up to 8 cm. thick. It is occasional in all parts of the island, at times in some local abundance, but is generally seen as only an isolated branch twining in thicket. Some bushy examples of the species can be seen at the foot of the bank across the road to the northwest of the Officers Club. The three acuminate leaflets of the compound leaves are 5–15 cm. long, 2.5–7 cm. wide, and are green above and pale beneath with prominent ribs and veinlets. The coarse flowers, 5–6 cm. long, are white, flushed with pink, and have red lineate markings on the standard. The brown strigose pods, 7–30 but usually 15–20 cm. long, are broadest (12–25 mm. wide) towards the end, which is tipped by a slender, obliquely deflexed beak about 2 cm. long. I collected flowers and fruits as early as October, and Erlanson got them as late as the end of May. The chief reproductive period is probably the dry season.

The species is known only from Panama and possibly Costa Rica. In the past it has been confused with *C. arborescens* Aiton, a plant of northern South America, which has glabrous pods, larger, more conspicuous bracted racemes, and less pointed leaflets that are more finely reticulate and soft hairy beneath. (Fl. C. Z. p. 215, sub *C. arborescens*). *Johnston 538, 628, 670, 1351; Erlanson 29, 35, 177; Andersson.*

Clitoria rubiginosa Juss.

An herbaceous twiner with slender hairy stems, growing in grass and on brush in open places at the summit of sea cliffs at East Harbor and in disturbed places in the grassland on Bald Hill. The three leaflets of its compound leaves are elliptic, 3–6 cm. long, 1.5–4 cm. broad, green and glabrous above, and pale and minutely hairy beneath. The conspicuous flowers, first appearing in October, are about 3 cm. long and are white or yellowish with violet linings on the standard. The thick biconvex pods are 2.5–5 cm. long and 7–9 mm. high, and are matured in January and early February. The species is found in the West Indies, Central America and northern South America. (Fl. C. Z. p. 215). *Johnston 195, 829; Harlow 84.*

Crotalaria pilosa Mill.

An erect, simple or sparingly branched herb, up to a meter tall, which is frequent in parts of the grassland on Bald Hill at the close of the rainy season. Its conspicuously winged stems, elongate simple leaves, and inflated pods 3 cm. long permit its ready recognition. The species is widely distributed in the American tropics. Our plant is the hairy form described as var. *Skutchii* Senn. (Fl. C. Z. p. 207, sub *C. pterocaula*). *Johnston 22; Erlanson 480.*

Dalbergia Brownei (Jacq.) Urb.

A common shrub with simple leaves growing in thickets near the coast and usually about banks and large rocks. The numerous, much branched, slender stems lean and trail over rocks or are piled on one another to form impenetrable masses 15–25 dm. tall. Its largest stems are only 2–4 cm. thick. A large mass of the plant is to be seen at the head of South Beach on the bluff

just west of the end of the road. In clambering the plant wraps its twigs once about a supporting branch, making a kind of half hitch which is very distinctive. Its leaves are glabrous, oblong-ovate, and 4–10 cm. long and 2.5–5 cm. broad. The small white pea-like flowers, about 7 mm. long, are borne in dense clusters along the stem. They are rather conspicuous for a time during March. The fruit is a flattened, rugose, indehiscent pod, 1.5–4 cm. long and 8–16 mm. broad, matured in June. The species is widely distributed along coasts in the West Indies, Central America, and northern South America. (Fl. C. Z. p. 220). *Johnston 492, 516; Erlanson 8, 433.*

Desmodium angustifolium (HBK.) DC.

An erect, loosely branched, slender annual herb, usually a meter or more tall, which grows scattered in the grassland on Bald Hill and much less commonly in open places with thin soil on the eastern peninsula. A single plant was found along a trail cut through thicket in Area 11B. The plant has slender, elongate, simple leaves 10–15 cm. long and 5–10 mm. broad. The small flowers are whitish and the jointed pods are about 2 cm. long. The species ranges from Mexico south to Colombia. For the determination of this species, as well as other members of the genus, I am indebted to Dr. Bernice G. Schubert. (Fl. C. Z. p. 211, sub *Meibomia angustifolia*). *Johnston 370, 1269.*

Desmodium axillare (Sw.) DC.

Trailing in shaded, usually damp places in forests, especially on disturbed soils, and frequently covering large areas on banks and along forest roads. Its ascending flowering stems, produced at the close of the rainy season, seldom exceed 3 dm. in height. The three ovate leaflets of its compound leaves are hairy, 4–8 cm. long, and 2–5 cm. broad. The flowers are pink. The broad jointed fruit is 1–2 cm. long. The species ranges widely in the American tropics. The island plant is the variety *acutifolium* (Kuntze) Urb. (Fl. C. Z. p. 211, sub *Meibomia axillaris*). *Johnston 98, 454; Erlanson 296.*

Desmodium barbatum (L.) Benth.

An erect annual herb, 1–10 dm. tall, which is frequent in the grassland on Bald Hill and on thin soil areas of the eastern peninsula, particularly above the sea cliffs at East Harbor. The three elliptic leaflets of the compound leaf are 1–4 cm. long, green above and pale beneath with abundant appressed silky hairs. The small flowers are pink. The jointed fruit is borne in globose clusters. The species is widely distributed in the American tropics. (Fl. C. Z. p. 210, sub *Meibomia barbata*). *Johnston 27, 672, 826.*

Desmodium canum (Gmel.) Schinz & Thell.

An introduced weed, first collected at the Navy Station in May 1945, where it had become well established and very abundant by January 1946. In January 1946 it was well established and fruiting in the lawns at Main Camp. The plant is perennial and has erect, slightly shrubby stems 3–10 dm. tall. The three leaflets of its compound leaves are 2–6 cm. long and 1–3 cm. broad, and are green above and pale beneath. The small flowers are pink. The jointed fruit becomes 2.5 cm. long. The joints adhere to clothing, making the plant a pest, and one, unfortunately, that will probably spread to become

a common roadside weed on the island. The species is widely distributed in the American tropics. (Fl. C. Z. p. 211, sub *Meibomia cana*). *Johnston 1006, 1086; Erlanson 131, 592.*

Desmodium procumbens (Mill.) Hitchc.

This slender annual herb was found a few times in open places with thin soil on the eastern peninsula where it appeared to be native. These plants were laxly decumbent. In January 1946 a single slender, erect plant, apparently introduced, was found growing with other weeds in the lawn near Headquarters. The three ovate or lanceolate leaflets are 1.5–4 cm. long. The jointed fruits are 1–3 cm. long. The species is widely distributed in the American tropics. (Fl. C. Z. p. 211, sub *Meibomia procumbens*). *Johnston 542, 1005.*

Desmodium Scorpiurus (Sw.) Desv.

An introduced weed with slender, much branched trailing or prostrate stems which, in January 1946, was well established about the Navy Station and also in the lawns at Main Camp. The three elliptic leaflets of its compound leaves are 1–2.5 cm. long and 7–20 mm. broad. The very slender jointed fruit is 2–3 cm. long. The species is widely distributed in tropical America. (Fl. C. Z. p. 210, sub *Meibomia Scorpiurus*). *Johnston 1000, 1092.*

Desmodium triflorum (L.) DC.

A creeping plant, suggesting a clover plant in habit, collected in disturbed ground at Main Camp by Erlanson in August 1945. It was persisting as a rare weed in the lawns about Headquarters six months later. The species is widely distributed in the American tropics. (Fl. C. Z. p. 210, sub *Meibomia triflora*). *Erlanson 589.*

Dioclea megacarpa Rolfe.

A coarse, loosely branched, woody vine rather common in thickets and low trees, particularly those within about a half-mile of the coast. Some large plants, readily observed, grow on the bushes near the Lookout on the west side of East Harbor. In large old individuals the main stems may become 5 cm. in diameter. The bark is thick and much roughened by numerous protrudent corky-margined lenticels. When cut it oozes gory exudations. The vigorous slender young shoots are twining and clothed with conspicuous spreading hairs. The leaves, which are shed during the dry season, are compound, being composed of three elliptic leaflets 8–15 cm. long. The handsome pea-like flowers, produced most abundantly early in October, are royal purple and about 2 cm. long. They are borne in stiff racemes 15–45 cm. long projecting from the mass of the plant. The axis of the raceme is stiff, woody, long persistent, and studded with knobs on which the flowers develop. In the flowering state it is terminated by a cluster of spreading, usually somewhat bristly slender bracts 1.5–2 cm. long and 1–2 mm. wide, and is brownish and clothed with short hairs. Although it produces many flowers, the inflorescence rarely matures more than one or two pods and in many cases none at all.

The pods are large and become very conspicuous about February, hanging as they do and maturing on vines that have shed most of their leaves. The pod is huge, 15–20 cm. long, 4.5–6 cm. high, and 3.5–4.5 cm. thick, somewhat

curved and very plump when mature. It is coated with a velvety or plush-like covering of stiffish tawny hairs. This tawny coat is very conspicuous and dense on immature pods, and, although thinned out and darkened on old ones, it is still obvious. The curved upper edge of the fruit is 1–1.5 cm. wide and is traversed by three strong rounded ridges. The lower side, slightly thicker and more rounded than the upper, is first rounded, but at maturity is somewhat flattened. It eventually splits longitudinally down a medial line, with the resulting edges inrolling to form a slit-like fissure opening into the central cavities of the pod and then appears to be sulcate. This medial fissure on the lower edge of the pod never becomes more than a few millimeters wide. The pod opens no further and apparently never sufficiently to free the 2–5 (commonly 3–4) seeds it contains. Seeds are freed only after the pods are riddled by insects or fall to the ground and decay, processes which may be expedited by the free entry of insects or other organisms of decay into the pod through the otherwise seemingly useless fissure along its lower margin. In lateral outline the end of the pod has a sweeping upward curve, with its point, where the style was formerly borne, located at the outer end of the upper edge of the pod and almost at the same level.

The large, very plump, biconvex seeds, 2.8–3.1 cm. in greatest diameter, are rather smooth and lustrous, and usually caramel or butterscotch color, PLATE 8, FIG. 3. On the edge they are two-thirds encircled by a narrow attachment scar that is light in color and is margined by a narrow, slightly swollen rim which usually has a darker shade than that predominating on the sides of the seeds. These seeds may be found, with other sea-beans, washed up on the beaches of the island. In beach drift they appear to be less common than the seeds of other *Dioclea* species, but are readily distinguished by their larger size, more rounded sides, and lighter coloring. Like the seeds of *Dioclea reflexa*, they are frequently found washed out of the soil after heavy rains along sections of new road cut through thicket.

I have seen collections from Trinidad, Tobago, Santa Margarita Island off Venezuela (pod only, *J. R. Johnston 359*) and Panama (Barro Colorado, *Bangham 608;* Llano Bonito, Cocle, *Seibert 540*) as well as copious material from San Jose. Amshoff, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht **52:** 66 (1939) reports it from Paraguay, Brazil, Bolivia, Peru, Colombia and the Guianas in South America. Recent reports of the species from northern Central America, Standley & Steyermark, Fieldiana **24**[5]**:** 242 (1946), appear to be based, largely if not exclusively, upon material actually representative of *D. violacea*. *Johnston 53, 53A, 53B, 360, 568, 647, 1176; Erlanson 408; Harlow 3.*

Dioclea reflexa Hook. f.

A woody vine of forests and thickets, particularly those on the northern half of the island and those more than a half-mile inland. In some forests it is one of the most abundant vines in the canopy. On the southern half of San Jose it was found at only a few scattered places. Though primarily an inland plant it occasionally grows on thickets near the coast and sometimes in the company of *D. megacarpa*. The leaves greatly resemble those of that species, but have a more lustrous upper surface which, when viewed under a lens, has also a more prominent reticulum of veinlets. Furthermore, unlike that species, the present one does not shed its leaves and remain leafless dur-

ing most of the dry season. The main stems may become 5 cm. thick. Its bark is less roughened than that of *D. megacarpa* but produces similar thick gory exudations when cut. The vigorous new shoots of the plant are twining and are clothed with abundant hairs that are distinctly appressed. The flowers have a white keel and a pink standard and develop in greatest abundance at the end of December. They are slightly smaller, very much lighter in color, and appear several months later than those of *D. megacarpa*. They are borne in similar stiff racemes, which may become as much as 7 dm. long. The axis of the inflorescences persists for months, even when sterile, and is roughened by numerous prongs about 5 mm. long, on which the flowers are borne. The axis of the racemes, the buds, and the very young fruits are clothed with appressed brownish or rusty hairs. The bracts of the racemes are very distinctive. They are 1–2 cm. long, 2–3 mm. wide, distinctly recurving, and clothed with appressed hairs which are brown on the lower surface and commonly gray or silvery above. The mature pods are glabrous, 10–15 (or rarely 20) cm. long, 4.5–5.5 cm. high, and 1.7–2.4 cm. thick. Viewed laterally they have the upper and lower edges both curved and the distal end pointed, with the point only slightly supramedial. The upper edge of the pod is 5–10 mm. broad and has thick upturned margins. The more narrow lower edge, 2–4 mm. broad, is sulcate, with a longitudinal groove that eventually deepens into a slit-like fissure opening into the interior of the fruit. The fruit develops this slit but opens no further. The 3–4 seeds it contains are freed only after the pod is destroyed by insects or falls to the ground and decays. The hard biconvex seeds, 2.6–2.9 cm. in greatest diameter, are usually tan, brown, or dusky, and rarely mottled. They are three-quarters encircled by a narrow, usually dark attachment scar which is bordered by a narrow, usually obscurely swollen light-colored margin. These seeds much resemble those of *D. megacarpa*, but are usually slightly smaller in size, less plump, and brown or dusky rather than caramel-colored. They are very frequently found washed up on the beaches, PLATE 8, FIG. 4–5.

The species is known from Panama, northern South America, the West Indies, and tropical West Africa. It was originally described from tropical West Africa and is one of the group of species with ocean-dispersed seeds that is shared by the West Indies and tropical West Africa. Related plants of East Africa, Madagascar and the East Indies have been identified with *D. reflexa* but they are obviously not conspecific. The seed of *Dioclea* found in the West Indian drift have been generally identified as *D. reflexa*. This may have been correct in most cases, but it is to be noted that *D. megacarpa* and *D. violacea* also grew in regions where their seeds can be cast into Caribbean waters and so can be expected also on the beaches of the West Indies and those bathed by the Gulf Stream. Unfortunately, the identity of such drift seeds will always be in doubt, for the differences between those of the species mentioned are sometimes elusive. (Fl. C. Z. p. 216). *Johnston 473, 615, 653, 711, 1033, 1131, 1207, 1254.*

Dioclea violacea Benth.

A woody vine found on the island only in the thicket area along Navy Road. It was beginning to flower freely early in November 1944 and was bearing mature pods in January 1946 and in April 1945. Though it flowers a month later than *D. megacarpa* and a month earlier than *D. reflexa*, like these species

it may be found laden with fruit during early months of the year. Without flowers or fruit the plant is distinguished with difficulty from *D. reflexa*, since in vegetative characters and habits it is very similar. Distinctive of *D. violacea* is the very dark purple or almost black indument of short appressed hairs that clothe the inflorescence, bracts, buds, and very young fruit. The bracts of the raceme are slender, erect, 5–10 mm. long and 1–2 mm. wide and, like the bracteoles, are early deciduous. The bright purple corolla is lighter in hue than that of *D. megacarpa* and an entirely different color than that of *D. reflexa*. The pod, glabrescent at maturity, is 10–15 cm. long, about 5 cm. high and about 2 cm. thick. In lateral outline it is suggestive of the silhouette of the hull of a sturdy fishing schooner. The upper edge is nearly straight, flattened on top, margined by knife-like diverging flanges, and 1–1.3 cm. in total width. The lower edge is curved, sweeping up at the outer end into a nearly vertical prow, with the point, on which the style was borne, almost in line with the upper margin of the pod. The lower edge is very narrow and keel-like and only 1–1.5 mm. thick. It has no groove deepening into a slit which opens into the interior of the pod, as in the fruit of two other species of the genus on the island. The pods of *D. violacea* are completely indehiscent, not incompletely so as in the other species. The island plant has commonly 3–4 seeds in each pod. Except that the seeds are brown with conspicuous black mottling, they are indistinguishable from those commonly produced by island plants of *D. reflexa* (? PLATE 8, FIG. 2).

The species is known from Central America (British Honduras, Honduras, Guatemala and Panama), from Trinidad and Granada, and from the Guianas and Brazil. Various plants of the Old World have been referred to the species, but they are not conspecific. Good illustrations of the pods of *D. violacea* and *D. reflexa* and a detailed statement of the characters of these species have been given by Ducke, Arch. Jard. Bot. Rio Janeiro **4:** 97, t. 4 (1925). (Fl. C. Z. p. 216). *Johnston 418, 612, 1170.*

Erythrina glauca Willd.

Represented on the island by several trees 4.5–6 m. tall, growing at Orange-tree Beach. The twigs bear weak paired stipular thorns. The three leaflets of its compound leaves are elliptic and 10–15 cm. long. The coarse flowers, not seen on the island, are orange in color and borne in loose terminal racemes. The species ranges from Guatemala and Cuba south to northern South America and is usually found in low ground, especially stream banks, swamps, and overflowed land. (Fl. C. Z. p. 212). *Johnston 955.*

Galactia striata (Jacq.) Urb.

A very slender, twining vine forming netted growth in roadside thickets and in undergrowth in open forests on the eastern peninsula. The three leaflets are elliptic or nearly lanceolate, 2–5 cm. long and 1–2.8 cm. broad. The small pink flowers, appearing at the close of the rainy season, are borne in slender open racemes. The flattened pod, appressed hairy on the sides, 4–6 cm. long and 5 mm. wide, is usually strongly up-curved beyond the middle.

A variable species ranging from Mexico and the West Indies south into northern South America. (Fl. C. Z. p. 217). *Johnston 161, 364, 1103.*

Indigofera suffruticosa Mill.

A single colony of this small bush was noted at the roadside a few hundred yards north of Bald Hill. It is a grayish, slender-stemmed shrub 1–2 m. tall. The small flowers are pink. Its gray-green, pinnate leaves, 5–10 cm. long, have 11–13 leaflets. The slender curved pods are 10–15 mm. long. The species is widely distributed in tropical America. (Fl. C. Z. p. 208). *Johnston 1060.*

Lonchocarpus pentaphyllus (Poir.) DC.

A small tree, 3–9 m. tall, growing on a rocky beach at Navy Cove, on the sandy beach at OrangeTree Beach, and in a rocky ravine on the coast at the mouth of the stream draining Area 8D. Only a few trees were present at each place. All were infested with ants, which tunnel and inhabit stems and even the axes of inflorescences, commonly causing conspicuous distortions of the latter. Gall-like distortions inhabited by biting ants may even be present on the rhachis of the pinnate leaves. The trunk of the tree is usually 8–20 cm. thick, with the largest seen measuring 28 cm. in thickness. The seven elliptic leaflets, 7–16 cm. long and 4.5–7.5 cm. broad, are pale beneath and green above. The maroon, pea-like flowers, 8 mm. long, are borne in clustered dense cylindrical racemes 5–10 cm. long.

The species ranges in Central America, the West Indies and northern South America. This plant has generally passed as "*L. latifolius* (Willd.) HBK.," and usually given as based upon *Amerimnum latifolium* Willd., Sp. Pl. **2:** 909 (1800). The latter is founded upon a description and illustration of a tree from Cartagena, collected by Jacquin, which is obviously not the present plant and perhaps not even a member of its genus. Humboldt, Bonpland & Kunth, when they established the genus *Lonchocarpus*, listed in a footnote a number of species probably belonging to that genus, but made no combinations. One of these listed species was "*Amerimnum latifolium* Willd. (teste specim. a Balbisio mecum communic. ab Amerimno pinnato Jacq. tamen longe diverso)." The combination "*Lonchocarpus latifolius*" was first published by DeCandolle, Prodr. **2:** 260 (1825), who excluded references to Willdenow and Jacquin and apparently described a plant from Porto Rico, presumably some of Bertero's material distributed by Balbis, which seems to be our present plant. This, of course, was improper. The first legitimate name for our plant is *L. pentaphyllus* (Poir.) DC., Prodr. **2:** 259 (1825), based upon *Dalbergia pentaphylla* Poir. in Lam. Encyc. Suppl. **2:** 445 (1811). (Fl. C. Z. p. 219, sub *L. latifolius*). *Johnston 251, 775; Erlanson 57.*

Machaerium marginatum Standley

A very coarse woody vine with unusual habits and distinctive appearance, which is occasional in thickets and forest. It was observed in thickets along Canyon Road, south of Pump Ravine, west of South Beach and along Navy Road, and in forests in Area 11B, near the north end of Little Butch Trail, in the valley at the head of Navy Cove, and along the Marino near Red Hill, but in abundance only along the Navy Road and near Red Hill.

Distinctive of this plant are its scattered, usually straight, practically unbranched, coarse leafy stems, 3–4.5 m. long and 1.5–2.5 cm. thick, which project out high above the thicket or treetops. Notable also are the very thick, stout, slightly recurved pairs of stipular thorns, 5–10 mm. long, and the very

abundant stiff slender prickles, 1–4 mm. long, borne on these stems, and particularly the younger ones. The long, pole-like stems of the plant, which bear most of its leaves, project erect or slightly curving out of supporting vegetation, and continue to elongate over a period of years until their length becomes too great, when, still nearly straight, they lean over more and more and come to rest horizontally on adjacent treetops or thicket. In this latter position they are soon overgrown by vegetation and become leafless stems that give forth new leafy poles and spread the plant more widely in the supporting thicket or forest canopy. The coarse thorny main stems can be traced in the thicket on Navy Road for considerable distances, and I am prepared to believe that what appears to be a large colony of the plant there may be no more than the widely spread parts of a single individual plant. Similarly, an investigation indicates that the fine display of the plant on top of the streamside forest that is visible to the south from the Marino Bridge is likewise only parts of one or very few plants. Only on the trail up the west side of the Marino, for about a quarter-mile above the bridge, were many individuals of the species seen. There a large number of the unmistakable stems, some as much as 10 cm. thick, were seen rising to the canopy of the streamside forest above. When cut they oozed much blood-like, somewhat resinous juice. All stems had a central pith 4–7 mm. in diameter surrounded by about a centimeter of dense wood, which in large stems is usually succeeded by wood made up of large vessels. No young individuals of the species were seen. It seems probable, however, that the plant reaches treetops by sending up its pole-like stems, which, if steadied by leaning on low branches, could elongate sufficiently to reach the heavy branches of the forest canopy. This would account for the fact that many of its stems seen in the forest proceed vertically from the forest floor with a directness and straightness unusual in vine stems. It would also account for the fact that in large main stems porous wood, characteristic of vines, is laid down surrounding a large core of dense wood such as is usually found in shrubs and trees.

The large glabrous leaves are pinnate, with 9–13 lustrous lanceolate or oblong leaflets 8–12 cm. long and 3–4.5 cm. broad. They are shed in mid-January, leaving the plant nearly bare for a few weeks, while the pole-like stems go through a period of elongation and slow leaf-renewal. No flowering nor fruiting plants were found on the island. Reproduction is apparently confined to the period between mid-February and late March, when no botanizing has been done on San Jose. The species ranges from southern Mexico to Panama. (Fl. C. Z. p. 220). *Johnston 419, 769.*

Machaerium purpurascens Pittier

A thorny, clambering vine with slender woody stems, frequent in forests and thickets on the northern half of the island. It climbs high in forests, scrambles in thickets, and in clearings forms a loose bush up to 2.5 m. tall with gracefully outcurved branches. The pinnate leaves, with 17–27 elongate, oblong leaflets, 1–2.5 cm. long and 5–11 mm. wide, are clothed with slender, soft hairs, and are brownish when young. In age they are green and glabrous on their upper surface, and paler and appressed hairy beneath.

In climbing the mature plants scramble upwards, aided by the pairs of sharp, recurved, stipular thorns borne along their stems. During its period of active growth, in January, when it lengthens stems and renews leaves, the

plant sends out slender projecting branches 1–2 m. long. Eventually these are blown by the wind back against the mass of vegetation, where, held by their thorns, they continue to grow and become permanently affixed. Projecting out from a thicket along a road, these thorny shoots scratch savagely one who inadvertently brushes against them. One young plant of the species was seen. This was in the forest along Little Butch Trail. It twined upward in a steep spiral about a tree 15 cm. thick, and at frequent intervals sent forth very slender, leafless, horizontal twigs 2–3 dm. long, which not only embraced the trunk, but were securely hooked to its bark by the many recurved thorns they bore. It is the same type of behavior that Schenck, Bot. Mitth. aus d. Tropen **4:** 212 (1892), reports for some of the Brazilian members of this genus. From my observations it appears to be confined only to young plants of our species. Old plants have a roughly cylindrical stem that may become at least 8 cm. in diameter. They ooze much blood-like resinous juice when cut. All stems have a central pith 2–3 mm. broad. Stems in excess of 3–4 cm. in thickness usually show anomalous wood structure in the form of one or two narrow, concentric bands of included phloem, similar also to that reported in Brazilian species by Schenck, l. c. **5:** 171 (1893).

The flowers of the plant, pinkish purple and 5 mm. long, are borne in great numbers in terminal paniculate clusters 2–4 dm. long. I found the plants about the Lookout on the headland south of Bodega Bay in full flower February 4, 1946, but the period of general flowering on the island is several weeks later. The species is known only from Panama. (Fl. C. Z. p. 220). *Johnston 970, 1073, 1378.*

Machaerium Seemannii Benth.

A woody vine growing in trees overhanging the tidal inlet above the fish trap at the end of Canyon Read. It is a glabrous plant without thorns. The pinnate leaves are composed of usually 7 obliquely ovate or lanceolate leaflets 2.5–7 cm. long and 1.5–2 cm. broad. No flowers nor fruit were found. The largest stems, 3 cm. in diameter, oozed no gory juice when cut. The wood was relatively dense, uniform, and surrounded a central pith 1–1.5 mm. in diameter. The species ranges from British Honduras to Columbia. (Fl. C. Z. p. 220). *Johnston 1328.*

Mucuna Sloanei Faw. & Rendle

A large herbaceous vine draping shrubbery on OrangeTree Beach. Its stems grow vigorously in the wet season, but by February drop their leaves and apparently die back to the ground before the middle of the dry season. Most of its stems are very slender. The largest main stem seen was only 2 cm. thick and was limber and not very woody. The leaves have 3 broad leaflets 10–15 cm. long and are green above and pale and silky with appressed hairs beneath. The flowers are 5 cm. long and borne 6–12 together, hanging in umbellate clusters 8–12 cm. broad at the end of slender, pendent peduncles 5–15 cm. long. The inflorescence has very inconspicuous bracts. The hanging flower clusters are attractive but not readily seen unless the herbage is brushed aside to expose them. The color of the flowers appears to vary, perhaps with the season. On October 21, 1944, when I discovered the plant at OrangeTree Beach, it had just come into full bloom. The flowers were a good lemon yellow. On December 28, 1945, the same plants were maturing pods

but still bore some flowers. The flowers then were not yellow, but distinctly greenish and not very attractive. The pod, usually pointed at the ends, is 9–15 cm. long, 4.5–6 cm. high, and 1.5–1.8 cm. thick. Its upper edge is flattened and has flange-like margins. The sides are decorated by many diagonal knife-like ridges and densely clothed with coarse, easily detached pungent hairs that are tawny or orange in color and irritating if they pierce the skin. One to three seeds are matured in each pod. They are 2.3–2.6 cm. in diameter and 1.8–2.4 cm. thick, and are three-fifths encircled on the margin by a black attachment scar 5–6 mm. wide. Their convex faces are dusky or rarely somewhat reddish, and are minutely but distinctly roughened. These hard, plump seeds, one of the kinds of sea beans, are frequently washed up on the beaches in the American tropics. The colony of the plant at OrangeTree Beach very probably sprung from one of them. Unfortunately I have been unable always to distinguish them from those of *M. Mutisiana*, a common and widely distributed species on San Jose, which presumably contributed most of the numerous *Mucuna* seeds to be found on the beaches of the island. Seeds of *M. Sloanei* may be few in the beach drift on San Jose, but certainly they are occasionally present on strands in Bodega Bay in the general vicinity of the colony of the species at OrangeTree Beach, PLATE 8, FIG. 6. The species is widely distributed along coasts in tropical America, and is also found in tropical West Africa. (Fl. C. Z. p. 213). *Johnston 248, 530, 957.*

Mucuna Mutisiana (HBK.) DC.

A large herbaceous vine with very slender, more or less twining branches, growing over bushes and climbing up to 15 m. in trees. It is frequent along the coast and for about half a mile inland. The largest stem found was 2 cm. thick, flexible, and not very woody. The plant does most of its growing in the wet season and drops its leaves by March, dying back in the dry season. The compound leaves, which turn black in drying, have three ovate or elliptic, pointed, nearly glabrous leaflets 7–12 cm. long. The blades of the lateral pair appear to be digitately 4-ribbed at their very oblique base. The coarse flowers, grayish or greenish gray in color and 4–4.5 cm. in length, are borne on spreading pedicels 3–6 cm. long, in hanging radiate clusters 10–13 cm. in diameter, which dangle at the end of very slender, naked pendent cord-like peduncles 1–5 m. long. The inflorescence is at first a hanging umbellate cluster of flowers with a crowded central mass of buds and large bracts. Its axis, at first only 3–6 cm. long, lengthens as the floral buds unfold and eventually becomes 15 cm. and occasionally 30 cm. long before flowering is over. The conspicuous ovate or lance-ovate bracts, 1–2 cm. long, usually persist for some time. The cluster of flowers is normally suspended a meter or more above the soil or any mass of vegetation below them, and never let down close to it. Peduncles on plants growing on high trees may become 3–5 m. long, but those on plants draping lower growth may become only a few decimeters in length. Peduncle elongation, in fact, seems surprisingly well measured to fit the particular situation in which the flowers are to be hung. The flower clusters, or later the 1–4 large pods dangling on cord-like peduncles, attract attention and serve as a ready means of identifying the plant on San Jose. Numbers of them can be seen in the months from October to March swaying from branches of isolated trees standing in thicket

or from branches along roads cut through forests near the coast. They are particularly numerous along the south end of Playa Grande, and many of them may be seen pendent from the under side of the dense thickets overhanging the beach at that place.

The oblong pods are obtuse at both ends and 8–10 cm. long, 4–5 cm. high and 2–2.5 cm. thick. Their sides are decorated by numerous interrupted, transverse or slightly oblique rows of irregular laminar crests 4–7 mm. high, 5–15 mm. long and 0.5–1 mm. thick, and densely covered by a menacing coat of tawny, easily detached, very sharp pungent hairs that readily penetrate the skin, break off, and become very irritating. The pods mature 1–3 seeds but commonly only 2. The plump hard seeds are grayish or rarely somewhat reddish, 2.2–2.6 cm. broad and 1.5–2.6 cm. thick. Like the seeds of *M. Sloanei*, from which I have been unable to distinguish them, they are more than three-fifths encircled on the margin by a broad black attachment scar 4–5 mm. wide PLATE 8, FIG. 7. In lateral outline they are usually nearly circular, but occasionally they may be somewhat longer than broad. Their faces are minutely roughened, somewhat as if etched by acid. These seeds are one of the common sea beans washed up on the beaches of San Jose.

The species is known only from Panama, Colombia and Venezuela. In these countries it has been generally confused with *M. urens* (L.) DC. The latter, however, differs from our plant in a large number of strong characters. Its foliage is thicker in texture and its less oblique lateral leaflets have only 3 diverging veins at their base. The bracts of the inflorescence are early deciduous. The larger, usually irregular, pointed pods are terminated by a conspicuous, persistent, erect, subulate beak 2–3 cm. long, and become glabrous and even somewhat lustrous after the fall of their pungent hairs, and not grayish and dull with a persisting velvety indument as in *M. Mutisiana*. The seeds are 2.5–3 cm. broad, 1.4–1.7 cm. thick, and have an attachment scar 3–4 mm. broad. It is a somewhat larger seed than that of *M. Mutisiana*, but has less convex, even somewhat flattened faces, a perceptibly narrower attachment scar, and a definite tendency to be broader than long. It has been found a few times in Panama and Costa Rica (Gatun Station, *Hayes 134;* Valle de Anton, *Seibert 434;* Port Limon, *Pittier 16000*), but otherwise is confined to the West Indies, the Guianas, eastern Brazil, and tropical West Africa. It is apparently a rare plant in Panama, whereas *M. Mutisiana* is common there. Its distinctive seeds are apparently common in the West Indian drift, but I found none on San Jose. A good photograph of these seeds is to be found in the frontispiece to Guppy's book, "Plants, Seeds, and Currents in the West Indies." In that plate Fig. 5 is the seed of true *M. urens*, while Fig. 4 is the seed of *M. Sloanei*. The latter, however, might serve equally well as a photograph of the seed of *M. Mutisiana*. *Johnston 209, 245, 677.*

Phaseolus adenanthus Meyer

An herbaceous vine twining on low beach vegetation at Main Beach, Long Beach, OrangeTree Beach and Playa Grande. It is a plant of sandy beaches. One large flowering plant was noted in the grassland on Bald Hill growing with *Canavalia* on some broken sand bags. Its compound leaves have three somewhat thickish, glabrous, ovate or lanceolate leaflets 5–13 cm. long and 2–4 cm. broad. The attractive flowers, resembling those of garden Sweet Peas, are 2.5–3 cm. long and violet or purple in color. The bean-like pods, 8–12 cm.

long and 8–9 mm. wide, are slightly curved and have a short, decurved beak. The species ranges widely in tropical America. The island plant is the typical glabrous form. (Fl. C. Z. p. 217). *Johnston 871, 893, 1184, 1262; Andersson.*

Phaseolus longipedunculatus Mart.

A slender herbaceous vine twining in bushes or trailing on the ground. It was found on thin soil areas near East Harbor, in clearings near the Air Strip, and in disturbed places in the Bald Hill grassland. The leaves are clothed with abundant soft, short, minute silky hairs and have three leaflets. The latter are triangular-ovate, 3–7 cm. long and 2–3.5 cm. broad. The salmon-colored flowers, borne in long racemes, are conspicuous in late December and most of January. The attractive parts of the corolla are its pair of broad salmon wings 1.5 cm. long. The standard and keel are green and somewhat purplish, and only half as long as the brightly colored wings. The slender elongate pod is straight, deflexed, 6–8 cm. long and only 2–2.5 mm. thick. The species ranges from Panama to Paraguay. I cannot agree with recent authors who have treated it as conspecific with *P. gracilis* Poepp. (Fl. C. Z. p. 217). *Johnston 887, 1025.*

Phaseolus lunatus L.

An herbaceous vine twining on herbs and low bushes at Main Beach and at the roadside near the Officers Club. It is an introduced plant, first noted on the island in January 1946, and is the wild form of the cultivated Lima Bean. The species ranges from Mexico to Peru. (Fl. C. Z. p. 217). *Johnston 870.*

Phaseolus stenolobus Standley

A twining herbaceous vine climbing over bushes in thin soil areas near East Harbor. The three leaflets of its compound leaves are ovate to lanceolate, somewhat angular in outline, and 4–7 cm. long and 1.8–3.5 cm. broad. The large pea-like flowers, purple and green in color, are almost 3 cm. long. They are produced in abundance in late December. The straight pod is 10–12 cm. long, 4 or rarely 5 mm. broad, and tapers at the end into a nearly straight, slender, elongate beak.

The species, known only from Central America, may be only one of the phases of the more widely ranging *P. speciosus* HBK. It has the thin foliage, the loosely coiled keel, the spreading petals, and the slender, beaked, *Centrosema*-like pods of that species, but differs in having the lower calyx lobes subulate, 5–6 mm. long, and about 5 mm. wide. Typical *P. stenolobus* from Guatemala has the two faces of its leaves minutely bristly. The San Jose plant has glabrous foliage. *Johnston 841; Erlanson 254.*

Pterocarpus officinalis Jacq. Bloodwood

A large tree known on the island only in the swamp back of Main Beach. It grows sparingly along the landward side of the swamp. Several trees stand near the road to the beach, but the greatest concentration of them is in that portion of the swamp where fresh water prevails about the stream mouth some distance to the east of the road. It is a large spreading tree, 15–22 m. tall, which commonly branches 3–4.5 m. above the ground. The trunk is provided with irregular plank buttresses that taper off and branch into flattened snake-like roots which, projecting above swamp mud, may be traced 5–10 m. from the tree. The main trunk when cut exudes a blood-like juice,

"Sangre de drago," formerly used in medicine. The juice from cut branches or vigorous new trunks, however, is honey-like. The pinnate leaves have 7–9 lustrous oblong or elliptic acuminate leaflets 10–15 cm. long and 5–7 cm. broad. They are renewed during the middle of the dry season. The panicles of yellow flowers are probably produced at the end of the wet season. The indehiscent, biconvex fruit has thin margins and is usually asymmetric but at times nearly circular in lateral outline and 3–4 cm. in diameter and 1 cm. or less thick in the middle. The fruits are apparently matured in November or early December, since at the end of the year they are to be found in large numbers washed up on the beaches in Bodega Bay. The softer external tissues are soon weathered away, and as light asymmetric fibrous disks about 3 cm. broad (PLATE 11, FIG. 1) they continue to be found in beach drift in diminishing numbers until late in the dry season. The species is known from Central America, the West Indies, and northern South America. (Fl. C. Z. p. 220). *Johnston 789, 790.*

Rhynchosia calycosa Hemsl.

Twining and forming netted growth on low bushes in disturbed ground at the roadside near the Air Strip. The three leaflets of the compound leaf are 3–6 cm. long and 2.5–5 cm. broad and have the base obtusely angled and the apex acute. They are clothed with soft minute hairs and bear golden glands, and in these respects are similar to those of *R. precatorius*. The flowers, about 1 cm. long, are borne in elongate racemes and have the yellow corolla partially obscured by the large, broad, and very elongate calyx lobes. The species is known only from Panama and Ecuador and is not common. (Fl. C. Z. p. 214). *Johnston 1106.*

Rhynchosia precatorius (H. & B.) DC.

A slender twining vine occasional on thickets and on undergrowth in open forests. Seen only on the northern and eastern portions of the northern half of the island. The three leaflets of the compound leaves are ovate, rounded at the base, pointed at the apex, 5–10 cm. long and 2.5–7 cm. broad, and are covered with an inconspicuous minute soft pubescence. Viewed under a lens, their lower surface is dotted with minute golden glands. The small greenish yellow or nearly brown flowers, 8 mm. long, are borne in large numbers in axillary, frequently branched racemes. The fruit is a small, irregular, velvety pod 1–2 cm. long and 6–7 mm. wide, which is usually somewhat constricted in width between the seeds. The seeds, borne 1–2 per pod, are ovoid, about 5–6 mm. long, and attractively colored, being red about the hilum and on one end and black elsewhere. They are matured in greatest numbers about the end of February.

The species ranges from Mexico to Panama and northern Colombia. In the past it has been much confused with *R. phaseoloides* (Sw.) DC. and *R. pyramidalis* (Lam.) Urb. The latter is known only from Cuba, Porto Rico and Haiti. The former ranges widely in the West Indies and South America but has been found in Panama. It differs from *R. precatorius* in its very branching racemes and in its predominately black seeds that are red only in a limited area centering about the hilum. (Fl. C. Z. p. 214, sub *R. pyramidalis*). *Johnston 588, 1132, 1331; Erlanson 382.*

Swartzia darienensis Pittier NARANJILLO

Usually a small tree, 3–10 m. tall, with only rare individuals becoming as much as 18 m. in height. It is occasional on banks near streams in forests in all parts of the island and rather common on wooded islets and on forested cliffs along the coast. The firm, lustrous leaves, very suggestive of those of the OrangeTree in texture and appearance, are either simple or composed of three leaflets 6–14 cm. long and 4–7 cm. broad. The unusual flower has a single conspicuous broad yellow petal, 2–2.5 cm. long, and a mass of yellow stamens. The trees seem to be in general flower at least twice during the dry season, once at its beginning and again, perhaps more abundantly, at its end. The thick pods are orange, 2–3.5 cm. long and 1–1.5 cm. in diameter, and because of their color may attract attention. The seeds, produced 1–2 per pod, are bean-like, shiny black, 1–2.8 mm. long, and have a large white fimbriate aril which may ride on them saddle-like or at times nearly enfold them. The species is known only from Panama. (Fl. C. Z. p. 206, sub *Tounatea simplex*). *Johnston 510, 684, 782, 941; Erlanson 51, 221, 416, 425, 505, 538; Andersson.*

SESBANIA SESBAN (L.) Faw. & Rendle

A coarse, erect annual with pinnate leaves, occasional about the Goat Barn. It was found fruiting in January 1946. The plant was probably introduced in unclean hay. *Johnston 1146.*

TRIFOLIUM PRATENSE L. RED CLOVER

A few plants of this species, some flowering, were noted about the Goat Barn in January 1946. The species was introduced in hay shipped from the United States.

TRIFOLIUM REPENS L. WHITE CLOVER

Several well-established plants, some with maturing fruit, were found about the Goat Barn in January 1946. The species had obviously been introduced in hay from the United States.

Vigna luteola (Jacq.) Benth.

A slender viny herb trailing in usually shaded, damp places on beaches, and seen only at E. M. Beach and on the beaches in Bodega Bay. The three leaflets of the slightly fleshy, glabrous, compound leaf are elliptic or oblong, 2.5–7 cm. long and 1.5–4 cm. broad. The sordid yellow, pea-like flowers, borne in racemes, are about 1.5 cm. long. The slender pods are 4–8 cm. long. A coastal plant widely distributed in the warmer parts of America. (Fl. C. Z. p. 218, sub *V. repens*). *Johnston 757; Erlanson 2.*

HUMIRIACEAE

SACOGLOTTIS

Fruits, obviously of a species of this genus, were found occasionally in the drift on the beaches of Bodega Bay, PLATE 10, FIG. 3. Devoid of epicarp, they are broadly ellipsoidal, 4–5 cm. long and 3.4–3.8 cm. in diameter. The mesocarpic tissue originally contained an inordinate number of irregularly arranged, crowded, resiniferous vesicles of varying size. In the drift fruits these are mostly empty, and the mesocarp largely composed of numerous more or

less spherical cavities separated by thin walls of woody tissue. In worn fruits these cavities, located just beneath the surface of the mesocarp, all have their outer wall destroyed. The surface of these worn fruits, therefore, is very rough and seemingly much excavated. None contained viable seeds. In most cases the seeds were not only dead but dried and disorganized.

In its general structure this fruit much resembles that produced by *S. amazonica,* but differs from it in many details. The mesocarp of *S. amazonica* is smaller, 3.5–4.5 cm. long and 2.5–3.1 cm. broad, it is distinctly heavier and more woody, and has far fewer, much coarser cavities which are not irregularly arranged but are more or less two-ranked in each of the five sections of the fruit. Because of their tougher, more woody structure, drift fruits of *S. amazonica* have the surface of the mesocarp unbroken or at most broken over only an occasional cavity.

No species of *Sacoglottis* has been reported from the Pacific side of America, and not until recently was the first member of the family, *Vantanea Barbourii* Standley, from southwestern Costa Rica, reported from Central America. In the Gray Herbarium, however, there is a fruiting specimen of *Sacoglottis guianensis* Benth, collected on Cocos Island in 1902 by Pitter (no. *16260*), who noted that it was the largest of the island trees. The drift fruits picked up on San Jose indicate that another species of the genus remains to be discovered somewhere along the Pacific slope of America. I believe it will prove to be a well-marked, undescribed species related to *S. amazonica* Mart. and probably native of western Colombia.

Like the fruits of the unknown *Sacoglottis* from San Jose, those of *S. amazonica* were for many years a puzzle to those interested in the drift fruits of the West Indies. The tree producing them is known only from the Amazon Valley and from Trinidad and St. Vincent. The fruits, however, have been found on the beaches at Colon, on beaches of most of the West Indian islands, and even on the beaches of the British Isles. Though known to botanists for three hundred years, they were not identified as the fruits of *S. amazonica* until the close of the past century. Discussions and good illustrations of the fruit of *S. amazonica* can be found in the works of Morris, Nature **53:** 64–66 (1895); Hemsley in Hooker's Icones **6:** t. 2521 (1897); Guppy, Plants, Seeds, and Currents 133, frontispiece (1917); and Ducke, Arch. Jard. Bot. Rio Janeiro **5:** 142, t. 14, f. 36 (1930).

RUTACEAE

Citrus Aurantium L. SOUR ORANGE

Several large trees grow at the south end of OrangeTree Beach. They give no evidence of having been planted and apparently originated from fruit washed up by the tide. The species originated in Asia and is now widely distributed in the tropics as cultivated and naturalized plants. (Fl. C. Z. p. 223). *Erlanson 474.*

Zanthoxylum setulosum Wilson

A tree occasional in forests, particularly in the eastern and southern parts of the island. It is usually present as widely scattered individuals, but occasionally can be found rather numerous in limited areas, as, for example, in the woods at the west end of Englishman Beach. Many seedlings of the

tree have appeared in clearings and along roads, chiefly in forested areas. Some attained 4 m. in height in two years time. The species, accordingly, is becoming progressively more common on the island. I suspect that it is a weed-tree capable of developing rapidly in disturbed soils in openings in the forests, under conditions such as might be caused by the fall of a large forest tree. Numerous large individuals in a limited area, such as that found near Englishman Beach, perhaps can be taken as indications of a former clearing.

The tree commonly grows 6–12 m. tall but exceptionally can reach nearly 20 m. in height. The trunk, usually 10–15 cm., or rarely 20 cm. thick, bears characteristic coarse pyramidal outgrowths. These latter are spine-tipped. 2–3 cm. tall, and composed of hard laminated wood. When cut they break with clean smooth horizontal surfaces. They are usually present in conspicuous numbers, but in very old trees are subject to decay and may have entirely disappeared. The twigs are pubescent and are covered with small sharp thorns. The leaves are shed early in the dry season and the trees are bare for several months. The pinnate leaves have 15–25 leaflets and usually have scattered thorns on the rhachis. The leaflets, 5–12 cm. long, 1.5–4 cm. broad, are pointed. They are paler and hairy along the veins and midrib beneath and sometimes sparingly thorny as well. The flowers appear in the latter part of the rainless period. They are small and yellowish, with male and female on separate trees, and are borne in branched clusters 6–10 cm. long. The fruit consists of whorls of free, globose carpels 2–3 mm. long.

Seedlings less than a meter or two high bear little resemblance to the mature tree but may be readily recognized because of the conspicuous slender, straight, straw-colored thorns, usually 5–10 mm. long, which they bear in great numbers on the stems, leaf-rhachis, and on the midrib of the leaves. Young plants are entirely glabrous. Their leaves have 13–20 glabrous leaflets 2–6 cm. long and 5–15 mm. broad. In many places they have become very abundant along roads and in little-used trails in the forest. The species is known only from Panama. (Fl. C. Z. p. 222). *Johnston 150, 623, 737, 795; Erlanson 285.*

SIMARUBACEAE

Simaba Cedron Planch. CEDRON

A small tree with palm-like habit, locally common on a thicket-covered west slope along the middle section of Navy Cove Road. Scattered trees can also be found in the low forest along the switchbacks and even on slopes close to the Navy Beach. The plant has a simple trunk, 1–2 dm. thick and 2–5 m. tall, which is crowned by a conspicuous rosette of very large pinnate leaves 1–2 m. long. The leaves have about 18 pairs of leaflets which are green above and pale beneath, with the largest ones measuring 15–22 cm. long and 3.5–5.5 cm. broad. The foliage is renewed late in January. The inflorescence, produced chiefly during late February and early March, is a spreading panicle 12–18 dm. long. The flowers, 2–2.5 cm. long, are fragrant and have recurved lobes. The calyx is tawny, the corolla greenish, and the staminal tube nearly white. The fruit is ovoid, single-celled, 6–7 cm. long, and a rich reddish brown in color.

The species ranges in western Central America, Trinidad and northern South America. A good photograph of the leaves and fruit, incorrectly identified, is to be found in Standley's Flora of the Panama Canal Zone, plate 39. *Johnston 561; Erlanson 410.*

BURSERACEAE

Bursera Simaruba (L.) Sarg. GUMBOLIMBO

An aromatic tree frequent on areas with thin soil. It is found at various places on the eastern peninsula, as well as on exposed sea cliffs, on barren islets along the coast and on rocky ridges; invariably where the soil is scant and excessively dry during the rainless months. It is one of the distinctive deciduous trees that characterize such situations. Most trees are about 7 m. tall, but individuals 10–18 m. tall are not uncommon. A fine large specimen over 15 m. tall, with a trunk 5–6 dm. thick, is a well-known landmark on the East Loop a few hundred yards from East Road. Its plump, coppery brown trunk, which attracts attention, is a distinctive characteristic. The bark is constantly renewed with its outer layer peeling off in papery sheets. Beneath the papery outer layer the bark has a decidedly green layer and beneath that a thick mass of white inner bark which quickly darkens when exposed to the air. When the trunk is cut there is a turpentine-like odor and a slow exudation of a reddish resin. The leaves are pinnate and composed of about seven leaflets. These latter are acuminate, 8–10 cm. long, 3.5–5 cm. broad, minutely hairy on the midrib and veins beneath, and borne on petiolules 5–10 mm. long. The leaves are shed early in the dry season and not renewed until May. The brown fruit, 1 cm. long, borne in racemes, is conspicuous in the dry season, for it hangs for a long period on the leafless trees. The species ranges from Mexico and Florida into northern South America. (Fl. C. Z. p. 224, plate 40, sub *Elaphrium Simaruba*). *Johnston 63; Erlanson 107, 158.*

Protium McLeodii, sp. nov. PLATE 17, FIG. 1.

Arbor 3–18 m. alta; ramulis 3–8 mm. crassis striatis juventate minute evanescenterque puberulentis; foliis 2–4 dm. longis saepissime 9-foliatis rariter 5–11-foliatis; rhachi 12–20 cm. longa parti basali efoliolata 3–8 cm. longa; foliolis glabris oblongis vel oblongo-ellipticis 6–15 cm. longis 1.5–4.5 cm. latis, supra subnitidis costa et nerviis prominulis evidenter notatis, basi obtusis 5–9 mm. longe petiolulatis plus minusve asymmetricis, apice abrupte acuminatis (acumine obtuso lineari 8–15 mm. longo ca. 1.5 mm. lato), margine integris planis; nerviis utroque latere costae 13–18; inflorescentia gracili in axillis foliorum solitaria 4–8 cm. longa breviter pedunculata minute perinconspicueque puberulenta, ramis saepe sparsis divaricatis gracilibus ad 4 cm. longis; bracteis minutis latis 0.3–0.5 mm. longis; floribus pentameris flavescentibus subsessilibus 2.5–4 mm. longis (feminei minoribus); calyce cupuliformi, lobis triangularibus 0.6–0.7 mm. longis tubo subaequilongis; petalis 2–3 mm. longis 0.8–1 mm. latis margine papillatis alibi glabris; staminibus 1.5 mm. longis, antheris 0.4 mm. longis ovatis; ovario floris feminei tomentuloso basi disco 0.3–0.5 mm. alto tomentuloso circumdato; drupa 1.5–1.7 cm. longa asymmetrica 15–17 mm. crassa; pyrenis saepe solitariis rariter 2–4.

TYPE: *Johnston 557*, San Jose Island, Navy Road, tree 9 m., at edge of thicket.

A widely distributed tree on the island and rather common, forming bushy growth 3–6 m. tall in thickets, and in forests a tree usually 10–15 m. tall. The largest individual seen reached 18 m. in height and had a trunk 2.5 dm. thick. When injured the bark exudes small amounts of a clear, fragrant resin. The pinnate leaves have 5–11, but commonly 9, leaflets. The latter are usually oblong, noticeably veined, 5–15 cm. long and 1.5–4.5 cm. broad. They have petiolules 5–9 mm. long and have their tips conspicuously and slenderly

long-acuminate. When crushed they have a mild resinous odor which is not particularly pleasing. The foliage is renewed during January. Very young leaflets are somewhat grayish or grayish pink and do not attract much attention. The slender inflorescences, 4–8 cm. long, bearing small yellowish flowers, appear after leaf renewal in February and early March. The fruit is green, usually obliquely ovoid, 1.5–1.7 cm. long, and is matured during the latter half of the dry season.

The species is known only from San Jose and the adjacent island of Pedro Gonzales. It is most closely related to *P. neglectum* Swart of northern South America, from which it differs in its shorter inflorescences and in its thinner, more lustrous, more elongate leaflets with more numerous veins and longer, more slender acumination. Among the Central American species it is most closely related to *P. sessiliflorum* (Rose) Standley, from which it is readily separated by its much smaller, conspicuously acuminate, thinner, more elongate leaflets and shorter, more slender inflorescences. It is a pleasure to associate this tree with the name of Colonel R. D. McLeod Jr., Technical Director of the San Jose Project when I first visited the island in 1944. *Johnston 420, 557, 562, 586, 654; Erlanson 45, 67, 186.*

Tetragastris panamensis (Engler) Kuntze

An important forest tree on the northern half of the island. When present it always occurs in abundance and by numerical dominance produces the very distinctive type of forest which has been discussed in this paper as "Marino Forest." The largest stands of the tree occur in the upper Marino basin in Area 7A. Scattered stands, however, occur as far north as Bald Hill and as far east as Area 8B and the center of Area 8D. Southern extensions of the forests in Area 7A cross the East Road in the vicinity of the Central Met. Station. A grove of the tree occurs on the top of the hill just north of the Cross Roads. Further south *Tetragastris* is known only in the vicinity of the Physiological Laboratory and in the vicinity of Area 4C at the east end of the road between Areas 4 and 5. The tree accordingly does not occur south of the narrowest part of the island.

The tree is distinctly gregarious. I was unable to find an isolated specimen of it well separated from others of its kind. When present the species is practically always in considerable abundance, at least locally, with the individuals growing adjacent to one another and making up more than half of the canopy in a small or large tract of forest.

As it commonly develops on the island the tree is 10–20 m. tall and has a smoothish dark trunk 1–3 dm. thick. Larger examples, however, are not rare. Some large trees on the western slopes of Red Hill are at least 26 m. tall and have trunks 5–6 dm. thick. Like all other large old individuals they had rough bark that flaked off in thick plates. When the trunk is cut there is a distinctive spicy, somewhat turpentine-like but very pleasing odor and a slow exudation of clear resin.

The pinnate leaves are composed of 7–9 dark green thickish leaflets. These latter are 7–18 cm. long, 3–7 cm. broad, and have an angled somewhat asymmetric base and a broad apical acumination 10–15 mm. long. The tree renews its leaves gradually. While the handsome dark green crown is still densely clothed with foliage, crimson new leaves are developing at the ends of the twigs. Such trees, with their dark green splashed with crimson, could

be no more attractive if covered with gay flowers. The colored new foliage was to be seen on trees during every month I was on the island, but judging from my notes it was especially abundant during November 1944, March 1945, and January 1946.

The flowers are inconspicuous, greenish yellow, and borne in loosely branched inflorescences 3–5 cm. long, apparently about June. The fruit is a broadly turbinate pod attached to the pedicel at the middle of the flattened or centrally depressed broader end. In lateral outline it is broadest above the base and then slopes towards the apex, which is rounded or obtusely angled at the very summit. The fruit sizes up by the middle of the wet season while its ovules are still very small, and is noticeable on the trees for nearly a half-year before its seeds mature. It is fully ripe late in March or in early April, when it is about 1.8 cm. long and 2.5 cm. in diameter and becomes dark purplish in color. Its structure has never been adequately described. The fruit commonly has 5 carpels, but examples with 3, 4, or 6 carpels are not uncommon. When completely mature the leathery outer shell, part of the exocarp, falls away, exposing the pyrenes (i. e., bony endocarps), which are enveloped in a white gelatinous mesocarpial tissue and are seated between leathery plates of exocarp radiating from the central axis of the fruit. Exocarpial tissue is all leathery, purplish red, somewhat resinous, and 2–3 mm. thick. When the fruit first dehisces the mesocarp is white, opaque, rather firm gelatinous, and 1–2 mm. thick. An apical prolongation of this tissue is connected to the fruit axis and is joined to the latter in a subapical socket located just above the funicular attachment. The mesocarp is apparently hygroscopic and shortly after first exposure becomes glutinous and slimy. Later, however, it dries to a thin crust and is no longer white. The angular bony sections of endocarp, the pyrenes, each containing a single seed, are 10–13 mm. high. In dehiscence the fruit goes through the following steps. Sections of the exocarp over each pyrene fall off, usually individually. The mesocarp swells, breaking the funicle and loosening the pyrene in its seat between the exocarpic plates radiating from the fruit axis. Completely loosened and coated with white mesocarp, the pyrene is held for a time until the mesocarp severs its connection with the fruit axis. When this breaks, the pyrene, with its included seed, falls to the ground. The fruit axis falls last.

The trees matured great quantities of fruit in the season of 1944–45. In April 1945 the ground under them was littered with their fragments, shells, axes, and pyrenes, in great numbers. Surprising numbers of the seeds from this crop germinated during the wet season of 1945. In January 1946 one or more seedlings 1–3 dm. high were developing on every square yard of the shaded floor of forests of this species. Of the very few and widely scattered seedlings noted a year previous none had survived. A very scanty crop of fruit was maturing on the trees, in fact in many areas of *Tetragastris* forest little or no fruit seemed to have been produced. The species is known from British Honduras, Honduras, Nicaragua, Panama and the Guianas. (Fl. C. Z. p. 224). *Johnston 4, 138, 202, 275, 398, 658, 911; Erlanson 300, 342.*

MELIACEAE

Cedrella fissilis Vellozo — Spanish Cedar; Cedro amargo

A large tree characteristic of thin soils on bedrock and of rock outcrops on exposed slopes and ridges, always where it becomes excessively dry during

the rainless months. It is most abundant on the eastern side of the island, especially on the eastern peninsula, but is not confined to that locality. A number of trees grow at Max Point and others along the rocky ridges forming the skyline east of Camp. It is one of the trees that loses its leaves and remains bare during the dry season. In fact it is one of the characteristic members of the deciduous forest of San Jose. It is a handsome tree, having a heavy trunk, deeply furrowed and cross-checked bark, and a broad, widely spreading crown commonly 5–20 m. high and at times at least 25 m. in height. Its trunk reaches 9 dm. in thickness. The major roots are rarely buried and radiate widely, half exposed, over the shallow soil on which they grow. A characteristic grove of this tree containing some fine individual specimens is present on the East Road at the boundary between Areas 8A and 8B. When fresh the wood is white, but it darkens with oxidation. When dry it is reddish brown and has a spicy fragrance.

The pinnate leaves usually have 10–14 leaflets with the odd, terminal one usually absent. The leaflets are 10–18 cm. long and 4.5–7.5 cm. broad. Beneath they are minutely hairy, velvety to the touch, and slightly brownish. The apex is more or less acuminate and the base is obtuse or rounded and somewhat asymmetric. The leaf rhachis is 2.5–4.5 dm. long. In January the leaves turn yellow and are all shed. They are not renewed until the last of May or early June. The small white flowers are borne in very loose panicles 25–30 cm. long and 15–20 cm. broad and appear shortly after the leaves. The fruit is distinctive. It is a dry, brown ellipsoidal pod 2.5–3 cm. long, which at maturity, about February, splits into five sections, frees abundant winged seeds, and spreads into a star-like form. These pods are produced in great numbers and become conspicuous as the tree loses its foliage. Spread into their star-like form after freeing their seeds, they persist for some time like paper flowers decorating the otherwise barren branches that bore them.

The island plant is the same as the tree found along the Pacific slope of Costa Rica and Panama. It seems very similar to *C. fissilis* of eastern Brazil and is usually treated as conspecific with it, as I have reluctantly done. (Fl. C. Z. p. 225). *Johnston 166, 323, 1344; Erlanson 294, 303.*

Guarea culebrana C. DC.

Locally common in the valley forest near Camp, but found nowhere else on the island. A tree 10–20 m. tall with a narrow dark green crown of very large pinnate leaves. The trunk is straight, usually somewhat irregular in cross-section, and 2–5 dm. thick. Many good examples of the tree can be seen along the road to Englishman and Observer Beaches, since at one place the road passes through an almost pure stand of it. The narrow crowns of the trees, with their numerous huge pinnate leaves, can be studied to good advantage along the Main Road a hundred yards or so from the Camp Area. The great leaves are commonly about a meter long. They have 4–20 pairs of leaflets borne on a rhachis 3–12 dm. long. The leaflets, mostly oblanceolate, dark green above, paler beneath, and short acuminate, are 2.5–4 dm. long and 5–12 cm. broad. When numerous the largest pair of leaflets is that borne third from the apex of the rhachis. Those borne below it are gradually reduced in length. The lowest leaflets are not more than half the size of the upper largest ones. They are frequently elliptic in outline. The wood, at least in leafy branches, is not very strong. Standing beneath a tree loaded

with fruit I fired one charge of buck shot upward and was literally buried with branches descending upon me. The flowers are produced early in the wet season on large branched inflorescences 2–6 dm. long.

The fruit, a woody pod, matures in February and March and is top-shaped, terracotta red, 3–5 cm. long and 2.5–4 cm. thick, and split into 5 or 6 sections. It is usually slightly asymmetric with the top somewhat oblique and is produced in great abundance. The seeds are cinnabar red with a large white hilum. They are 13–24 mm. long and 6–11 mm. thick. In March the ground beneath the trees is almost covered with the split pods and red seeds. The species is known only from Panama. *Johnston 1, 645; Erlanson 488.*

Guarea Guara (Jacq.) Wilson

A tree, 6–15 m. tall, growing only at the east margin of the Camp Valley Forest just east of the Machine Shop. It has a rather spreading, dense crown and a trunk up to 3 dm. thick. The even-pinnate leaves have usually 10 leaflets which are 10–15 cm. long and 4–6 cm. broad. The inflorescence is racemose, short-peduncled, and 6–18 cm. long. Flowers are probably produced early in the wet season. The brown fruit, maturing in February and March, is globose, and 14–18 mm. in diameter. It splits into four sections when ripe and frees four red seeds, each 10–11 mm. long. The species ranges from Mexico and the West Indies south into South America (Fl. C. Z. p. 226). *Johnston 283, 601.*

Trichilia acutanthera C. DC.

A tree 5–12 m. tall with a trunk 1–3 dm. thick, which was observed at only two places on the island: on top of the bank at the back side of the swamp at Main Beach and again along East Road several hundred yards east of the Loop. At both places it grows in rather open mixed forest and is represented by only a few individuals. The pinnate leaves have a rhachis usually 10–15 cm. long bearing 5–9 thickish, rather firm leaflets. The latter are 6–15 cm. long, 2.5–8 cm. broad, green above, pale beneath, and have 11–15 pairs of nearly parallel, apparently unbranched veins. Their apex is abruptly narrowed into a short, obtuse tip. The plant flowers in February and March, as the tree slowly renews its leaves. The flowers are white, small, and borne in racemes or panicles. These inflorescences are produced on the older twigs and are narrow, elongate, and 5–25 cm. long. No fruit was seen. The species ranges from Guatemala to Panama. (Fl. C. Z. p. 226). *Johnston 584, 585, 1341.*

Trichilia hirta L.

A small tree becoming 10 m. tall, which grows sparingly at the margin of the valley forest near the Motor Pool and along the near-by Cut Off, and also along wooded ravines on the eastern peninsula. Less than fifty trees were seen on the island. The pinnate leaves have 9–15 nearly glabrous, rather thin leaflets 4–9 cm. long and 1.5–4.5 cm. broad. The latter are green above, pale beneath, and have an acute, somewhat asymmetric base and a slender long-attenuate tip. No flowers were seen. Trees that were conspicuous with an abundance of brown, depressed, globose capsules 7–9 mm. long were seen in all months from October to February. The fruit splits into three broad, spreading sections when freeing the large pale seeds. The species

is widely distributed in tropical America. (Fl. C. Z. p. 226). *Johnston 159, 474.*

MALPIGHIACEAE

Bunchosia cornifolia HBK.

A large shrub or small tree usually growing on thin soil on islets and on and above cliffs along the coast. It was seen only at E. M. Beach, Main Beach, Englishman Beach and at East Harbor. The opposite leaves are elliptic or broadly lanceolate, obtuse at the base, acute at the apex, inconspicuously hairy, and 10–15 cm. long and 5–10 cm. broad. They are light green in color and are renewed late in January or in February. The plant seems to flower and fruit several times a year. The flowers are orange or yellow, 2–2.5 cm. broad, and borne in racemes 7–12 cm. long. The fruit, usually somewhat lobed, is orange when immature and cherry red, juicy, and 12–14 mm. broad when ripe. The species ranges from Nicaragua to Colombia. (Fl. C. Z. p. 227). *Johnston 167, 256, 1227; Erlanson 102, 395; Harlow 24.*

Byrsonima crassifolia (L.) HBK. NANCE

A tree frequent in the forests on the southern half of the island, particularly so in those along the South Road. Elsewhere on the island old trees are rare except in the fringe of the forest about the Bald Hill grassland where they are locally common. Many of its seedlings, however, appeared in clearings and along roads in various parts of the island, even in places where mature individuals are uncommon or even rare. The tree seems most at home in open woods and along forest margins, growing commonly 8–15 m. and rarely up to over 20 m. tall. The crown is broad and rounded. The trunk is usually 2.5–4 dm. thick, but can become nearly 1 m. in thickness. The dark bark, which becomes somewhat cracked with age, is covered with lenticel-slits which gradually develop very corky margins. The opposite firm, rounded, oblong or elliptic leaves are 10–15 cm. long and 4–9 cm. broad. Their under surface is clothed with brownish hairs which give a distinctly tawny cast to the green of the foliage. The leaves are renewed during January and February and turn orange, or orange spotted with maroon, or occasionally entirely maroon before they fall. The new foliage is grayish because of the thin fugitive pubescence on the upper surfaces. The principal period of flowering seems to be in March after leaf renewal, when the trees bear spikes of orange-yellow flowers in great numbers. There may be less general flowering at other times of year. The edible fruit, which suggests a miniature yellow apple, has a pleasing flavor, becomes 10–14 mm. in diameter, and is usually produced in great quantity. The species is widely distributed in tropical America. (Fl. C. Z. p. 227). *Johnston 20; Erlanson 25; Harlow 68; Campbell 2.*

Heteropterys laurifolia (L.) Juss.

A strong, high-climbing, woody vine growing in forests, mostly within a half-mile of the coast. It was found near South Beach, back of the Navy Station, on the hill at the head of Bodega Bay, about the margin of the mangrove swamp at the mouth of the Mata Puerco, and at several places on the eastern peninsula. Its main stems may become as much as 5 cm. thick. The new twigs are clothed with minute appressed brownish hairs, but its op-

posite, acute, lanceolate leaves, 7–14 cm. long and 3–6 cm. broad, are glabrous. The older twigs have many wart-like protruding lenticels. The small yellow flowers, about 13 mm. broad, are borne in small panicles and appear early in March. The winged fruit, 2.5–3 cm. long, with the wing 8–11 mm. broad, are produced in great numbers and are conspicuous on the trees in March and April. The species ranges from southern Mexico and Cuba south to Colombia and Venezuela. (Fl. C. Z. p. 228, sub *Banisteria laurifolia*). *Johnston 528, 705, 729, 765, 1080; Erlanson 157.*

Heteropterys macrostachya Juss.

A clambering, shrubby vine locally common in thicket at a few places along the west coast of the island. It occurs on Punta del Cabo, at E. M. Beach, on the slopes back of Communication Office, at the east end of Long Beach, on the headland north of the entrance to Bodega Bay, and on seaward slopes at the west corner of Area 11A. The firm opposite leaves are elliptic to lanceolate, 8–14 cm. long, 2.5–7 cm. broad, and are green above; below they are tan or golden from a coating of fine, appressed silky hairs. Their distinctive coloration permits the plant to be instantly recognized. The yellow flowers, 1 cm. broad, are borne in stiff, twiggy panicles. They were being produced in large number in October and November 1944 and still appearing in late December 1945 and in January 1946. The flowers have very conspicuous paired glands on four of their sepals. These glands are gray and are 2–3 mm. long.

The plant is supposed to have a winged fruit, a samara up to 6 cm. long with a body 6–7 mm. thick and a wing 2 cm. broad. Though I repeatedly searched for them during each of my three trips to the island, both on and under the plants, I found no such fruits. I doubt if the island plant produces them. As is normal in any inflorescence, a panicle of this vine drops most of its flowers after they have opened and have been exposed to pollination for a time. A goodly number, however, persist, gradually thicken their pedicels, and increase slightly in size. Examination of these shows that they contain an ovary with three living ovules. Such ovaries are hairy, ovoid, 2–4 mm. long and completely invested by the calyx and the distended, marcescent, staminal tube. I believe these function as fruit. I found them repeatedly and abundantly on the plants during all three of my visits to the island, and as late in the season as April, 1945. I suspect that the species behaves similarly in northwestern South America, for I have seen no specimens bearing samaras from that region. The species is known only from the southern West Indies and from northern South America. Plants reported from Costa Rica are not this species. *Johnston 388, 1377.*

Hiraea reclinata Jacq.

A common woody vine, high-climbing in forest, or, in thickets, clambering and hardly more than a reclining shrub. It is widely distributed and frequently very common on the northern half of the island and in places, also, on the western part of the southern half of the island. Its leaves are opposite, oblanceolate, usually acute, 8–15 cm. long and 3–7 cm. broad. They are broadest above the middle and gradually contracted towards the narrow, distinctly eared base, 1–2 cm. broad. These elongate leaves with the narrow eared base are very distinctive. The yellow flowers are 15–18 mm. broad and

are borne in umbels along the stem. Erlanson collected them at Camp on May 5, 1945. The fruit, which is 2–3 cm. long and has broad rounded papery wings, must be conspicuous but was not seen by me nor was it collected by Erlanson.

The species ranges from southern Mexico to Colombia. The name *H. obovata* (HBK.) Niedenzu has been generally applied to this plant, but *H. reclinata* is evidently an older one. Possibly the species should be more narrowly defined. The plants of Panama and Costa Rica differ from those of Mexico and northern Central America in having narrower leaves and shorter petioles, as well as in the low position at which the stipules are borne. (Fl. C. Z. p. 228, sub *H. obovata*). *Johnston 732; Erlanson 70.*

Stigmaphyllon ellipticum (HBK.) Juss.

A slender twining vine growing over low bushes and about the margin of thickets. It was seen west of Main Beach, at a few places on the eastern peninsula, and along the Loop and the roads going north from it. Only one or a very few plants were seen at each place. It is an uncommon plant. The leaves are opposite, elliptic or oblong, practically glabrous, and 5–13 cm. long and 3–6 cm. broad. Their base is rounded or somewhat cordate. The attractive yellow flowers, 3 cm. broad, are borne in branched umbels and appear at various times during the year. The fruit consists of 1–3 elongate, winged sections 3–4 cm. long. The species ranges from Mexico to northwestern South America. (Fl. C. Z. p. 229). *Johnston 352, 793; Erlanson 36, 520.*

Stigmaphyllon Lindenianum A. Juss.

A slender vine growing over thickets along the road back of Observer Beach. Its opposite leaves are long-petiolate and have a broadly ovate blade 8–13 cm. long and 5–10 cm. broad which is green above and gray beneath from a coating of appressed silky hairs. The plants came into bloom at the end of January 1946, and were in full blossom in February. The yellow flowers, 2 cm. broad, are borne in branched umbels. The winged fruit was not seen.

The plant develops large thickenings on its roots as storage organs. Along a vertical bank of undisturbed soil, in a cut made by bulldozers grading a new road, I had an excellent opportunity to study its underground parts. The roots of the plant, 5–8 mm. thick, descend vertically in the soil much deeper than those of the species associated with it, and enter only partially disintegrated subsoil. At levels varying from 5–20 dm. below the surface they are abruptly expanded into globose or broadly ellipsoidal storage tubercles 5–15 cm. in diameter. Most roots had only one such storage organ, but a few had two or three of them, one below another, separated by 5–10 cm. of unthickened root. Most of the tubercles were at least a meter below the surface in rocky, very poor subsoil. They were easily cut with a machete and had a pale, firm, moderately fibrous, juicy interior.

The species ranges from Mexico to Colombia. It is very closely related to *S. Humboldtianum* Juss., a South American species, and perhaps is no more than a variation of it, differing in having the indument on the leaves appressed and silky rather than loose and more or less tomentose. (Fl. C. Z. p. 229, sub *S. Humboldtianum*). *Johnston 1301.*

Tetrapteris discolor (Meyer) DC.

A high-climbing, woody vine of forests on the northern half of the island. It appears to favor open mixed forests and their margins and is neither abundant nor conspicuous. Its lustrous, glabrous, opposite leaves are 7–12 cm. long and 3.5–6 cm. broad. The small yellow or orange flowers, about 1 cm. broad, appear in October and November. The principal period for fruit development is probably early December. The only fruit seen was found February 15th, on a vine in Area 8D. Each of its three sections have several elongate, spreading wings. The pair of larger upper wings are 2 cm. long and 6–8 mm. broad. The lower pair are ovate and about 6 cm. long. The medial wing is 2–3 mm. tall and is the only appendage on the back of the fruit proper. The lower and upper wings are narrowly united between their bases along the side of the fruit.

The species ranges in Central America, the southern West Indies and in northern South America. Most plants of Central America seem to be good *T. discolor*, with the two pairs of wings not joined laterally at the base, and having the back of the fruit on either side of the medial wing not naked, but bearing numerous small appendages. The fruit of the island plant seems to place it in the form of the species described as *T. Seemanni* Tr. & Planch. (Fl. C. Z. p. 228, sub *T. Seemanni*). *Johnston 103, 369, 480, 1072, 1391.*

Tetrapteris macrocarpa, sp. nov.

Frutex scandens; ramulis juventate tomentulosis, maturitate glabratis; foliis chartaceis oblongis vel ellipticis vel late ovatis 10–15 cm. longis 5–8 cm. latis medium versus vel paulo infra medium latioribus, basi rotundis, apice acutis, subtus juventate tomentulosis maturitate glabratis; supra juventate pilis gracilibus laxe adpressis pallide vestitis maturitate glaberrimis; petiolis gracilibus 1.5–2 cm. longis; inflorescentia paniculata ramis dichotomis donata; bracteis conspicuis persistentibus, lamina late orbiculari vel subreniformi 1–1.4 cm. longa 1.1–1.6 cm. lata 2–3 mm. longe petiolata; bracteolis 1–1.2 mm. longis secundis sessilibus; floribus 1.7 cm. diametro; calyce glandulas 8 ad 3 mm. longas proferenti; petalis flava maturitate rubiginosis, limbo ad 7 mm. diametro margine eroso vel lacerato-dentato, ungue ca. 2 mm. longo; samaris pilis minutis adpressis inconspicue vestitis, nux ca. 0.8 cm. longo angulate subgloboso, alis superioribus 3.5–5.5 cm. longis 10–14 mm. latis inferioribus 8–13 mm. longis 3–6 mm. latis.

TYPE: *Johnston 58*, San Jose Island, Bald Hill Road, vine on forest margin.

A woody vine climbing high in open woods, on forest margins and on trees standing in thicket. It grows east of Camp, along the western portions of Dead End and Bald Hill roads, back of Playa Grande mangrove swamp, and at the east end of Mango Beach Jeep Trail; places all within a half-mile of the coast. Its glabrous opposite leaves are 10–15 cm. long and 5–8 cm. broad. The yellow flowers, 17 mm. broad, are borne in forking, terminal panicles and are intermixed with rather conspicuous, nearly orbicular bracts 10–15 mm. long. Erlanson collected them in June and July. The fruit is composed of three parts, each bearing two pairs of elongate wings. The upper pair of wings are 3.5–5.5 cm. long and 10–14 mm. wide, and the lower pair are 8–13 mm. long and 3–6 mm. wide. These straw-colored, many-winged fruits are conspicuous on the trees in October and November. On a few plants I found them numerous as late as January.

The species is known from Panama, Costa Rica and British Honduras. It is closely related to *T. calophylla* Juss., of northern South America, but differs in its loose tomentulose rather than fine strigose indument, in its smaller leaves with fewer veins, and in its very small appressed bracteoles. The species is that described by Small, No. Am. Fl. **25:** 126 (1910) under the name "*Tetrapteris glabrifolium* (Griseb.) Small," a binomial based upon *T. Calophylla glabrifolium* Griseb., Bonplandia **6:** 3 (Jan. 1858). Grisebach's trinomial was not described, but was accompanied by an allusion to the then unpublished treatment of the genus in the Flora Brasiliensis, **12**[1]**:** 77 (June 1858). In the account of the Brazilian species Grisebach described the variety *glabrifolia* from a collection made by Spruce in the upper Amazon. He mentions Panamanian material of our species but clearly states that it is not typical of the variety. The name "*T. glabrifolia* (Gris.) Small," accordingly, must belong to the true glabrate phase of *T. calophylla* and to a South American plant. Morton, Carnegie Inst. Pub. **461:** 132 (1936), has recently applied the name *T. acapulcensis* var. *macrocarpa* (Niedenzu) Morton to our present Central American plant. The varietal name, based upon *T. crispa* forma *macrocarpa* Niedenzu, Pflanzenr. iv. **141** (Heft 91): p. 214 (1928), almost certainly applies to it, if Niedenzu's measurements given for the width of the larger fruit wings can be dismissed as a typographical error. A study of the original description of *T. acapulcensis* HBK., Nov. Gen. et Sp. **5:** 168 (1822), however, will show that species to be very different indeed not only from our plant but from any other one found in Central America and Mexico, cf. Triana & Planchon, Ann. Sci. Nat. iv. **18:** 332 (1862). (Fl. C. Z. p. 228, sub *T. glabrifolium*). *Johnston 58, 438, 1036, 1252; Erlanson 405, 538.*

POLYGALACEAE

Polygala bryzoides St. Hil.

A slender, erect, simple or sparsely branched annual herb 1–3 dm. tall, which grows sparingly during the wet season on thin soil in open places at the top of the sea cliffs at East Harbor. The species is widely distributed in tropical America. (Fl. C. Z. p. 229). *Johnston 191; Erlanson 441, 483.*

Polygala longicaulis HBK.

A slender, erect, usually unbranched annual herb 15–45 cm. tall, which grows during the wet season on thin soil in open places at the top of sea cliffs near East Harbor and South Beach. The small pink flowers form a dense terminal cluster 9–13 mm. broad. The species is widely distributed in tropical America. (Fl. C. Z. p. 230). *Johnston 193; Erlanson 527; Harlow 22.*

Securidaca diversifolia (L.) Blake

A woody vine climbing in forests and on trees standing in thickets. It is widely distributed on the island and rather common. The leaves are firm, ovate, 4–8 cm. long and 2–5 cm. broad, and are lustrous and glabrous above and paler and minutely hairy beneath. The small pea-like flowers, 8–9 mm. long, are borne in slender racemes. About March they are produced in great quantities, and for a few weeks they adorn trees with masses of pink. The dry fruit has an elongate wing and is 3.5 cm. in length.

Stems over 2 cm. thick are usually somewhat flattened laterally and tend to be rounded-oblong in cross-section. They have anomalous wood structure,

and the larger ones, which may become at least a decimeter in thickness, show many narrow concentric bands of included phloem. The plant has specialized branches. Some of the lateral shoots, when young, wrap themselves once to several times about a support and then continue elongation. The vine, accordingly, is very securely tied to the supporting tree and so is capable of holding in position elongate shoots that project well out from the treetops. These shoots, forming flattened, gracefully curving sprays of herbage, are conspicuous on trees in January and February. They first grow erect, becoming 1–2 m. long, then very gradually sink to a horizontal position, and as they continue to lengthen, sink, in a month or two, until they hang down the side of the supporting tree, to which they eventually attach themselves. In January, when the plant renews its foliage and grows most rapidly, its broad projecting sprays, gracefully bobbing and swaying in every breeze, are very conspicuous because of their fresh green color, and are for a time one of the attractive details in the forest landscape.

Many seedlings of *Securidaca* have become established in disturbed soils along roads and in clearings. These first send up several slender, very sparingly branched, ascending and gracefully outcurving stems up to 10-15 dm. high that bear numerous crowded divergent and alternating leaves which progressively and very gradually increase in size from 0.5 to 4 cm. in length, as they are borne higher and higher up the stems. The species is widely distributed in tropical America. (Fl. C. Z. p. 230). *Johnston 527, 572, 903, 1067; Erlanson 33; Campbell 9.*

EUPHORBIACEAE

Acalypha arvensis Poepp. & Endl.

An introduced weed well established in the lawns at Main Camp by December 1945. The plant ranges from Mexico to Bolivia. (Fl. C. Z. p. 237). *Johnston 900.*

Caperonia palustris (L.) St. Hil.

A single small plant of this species, growing as a weed in the lawns at Main Camp, was collected Jan. 5, 1946. The species ranges widely in tropical America and is usually found in swampy places. (Fl. C. Z. p. 237). *Johnston 1042.*

Cnidoscolus urens (L.) Arthur Ortiga

A coarse herb or small shrub up to 2 m. tall which is occasional in sunny open places on thin soil near East Harbor. Its light green, palmately lobed leaves, 1–2.5 dm. broad, are crowded at the ends of the twigs. The tubular white flowers, about 8 mm. long, are borne in flat-topped, long-stalked, terminal clusters. The fruit is a capsule. The plant drops its leaves and dies back partially at the beginning of the dry season. It produces new shoots and foliage in February and comes into flower in late April and continues to flower and fruit during the wet season. The branches, leaves, and inflorescence are bristly with stiff, spreading, stinging hairs 3–8 mm. long. The plant must be treated with respect. A hand brushed against it feels as though pierced with red hot needles. The acute discomfort may last for several hours. The species is widely distributed in tropical America. (Fl. C. Z. p. 235, sub *Jatropha urens*). *Johnston 197; Erlanson 41; Harlow 82.*

CROTON HIRTUS L'Herit.

One plant, growing as a weed in the lawn at Main Camp, was collected in January 1946. The species is widely distributed in tropical America. (Fl. C. Z. p. 234, sub *C. glandulosus*). *Johnston 992.*

Croton trinitatis Millsp.

Small fruiting plants were collected by Erlanson on "rocky bluffs at East Harbor," early in June 1945. The species is widely distributed in tropical America. (Fl. C. Z. p. 234, sub *C. tragioides*). *Erlanson 246.*

Dalechampia scandens L.

A slender-stemmed, twining vine growing over low bushes in the thin soil area near the south end of the East Loop and again on thin soil, but in a disturbed area, near East Harbor. A large colony also grows in second growth along the Main Road east of Main Camp. It is an unattractive, weedy plant. The leaves are mostly 3-lobed and 3–8 cm. long, but some simple, cordate leaves are usually developed along with the more numerous lobed ones. The foliage and stems bear short spreading hairs which will irritate the skin and cause itching if the plant is handled or is brushed by bare skin while pushing a way through growth covered by the vine. The inconspicuous flowers and small hairy capsules are borne between a pair of green 3-lobed bracts, 1–2.5 cm. long. The plant seems to do most of its growing during the dry season. The species is widely distributed in tropical America. (Fl. C. Z. p. 235). *Johnston 396, 839.*

Dalechampia tiliaefolia Lam.

A slender-stemmed, twining vine forming netted growth on thicket. It appears to be uncommon and to be confined to the northern end of the island. A few plants, discovered when flowering in February, were found along Dead End Road, along Bald Hill Road south of Bald Hill, and in Area 11A. The broad, 3-lobed leaves, 6–13 cm. long, are slightly pale beneath. The two bracts which sheathe each inflorescence are rather showy and can make an attractive display on the plant when produced in abundance. They are cream-colored, ovate in form, 3–4 cm. long, and entire or three-toothed at their apex. The herbage of the plant, like that of the preceding species, is irritating to the skin if much handled. The species ranges in Central America and northern South America. (Fl. C. Z. p. 235, plate 42). *Johnston 1369.*

Euphorbia glomerifera (Millsp.) Wheeler

A weed on lawns and clearings about Main Camp, where it was first collected in May 1945 by Erlanson, and about Main Beach, where it was first found by Harlow in September 1945. I found it to be a well-established weed in both places in January 1946. In June 1945 Erlanson found it in "waste places on coastal bluffs at the Naval Station." The plant behaves like a recently introduced weed about Main Camp anl may very well be one. However, it also grows on rocks along the shore of Hicaco Island, where I am convinced it is a native plant. The specific ranges from Texas and Florida south to northern South America. (Fl. C. Z. p. 232, sub *F. hypericifolia*). *Johnston 862, 1007, 1196; Erlanson 181, 361; Harlow 49.*

EUPHORBIA HIRTA L.

An introduced weed well established by December 1945 on Main Beach and along the road just behind it. Erlanson collected the plant in the "Camp Area" in June 1945. A very widely distributed weed. (Fl. C. Z. p. 232). *Johnston 863; Erlanson 554.*

Euphorbia hyssopifolia L.

A slender-stemmed, erect, glabrous herb 3–10 dm. tall, with narrow, falcate, entire leaves. It is occasional in the Bald Hill grassland during the wet season. The species is widely distributed in the warmer parts of America. (Fl. C. Z. p. 232). *Johnston 325; Erlanson 577.*

Euphorbia thymifolia L.

A small prostrate herb which grows in damp soil at the head of E. M. Beach, where I first collected it in April 1945. In December 1945 it was also found in damp places at Main Beach. Erlanson has a collection made in May 1945 from "cleared land about Camp." It seems probable that the plant is native on the island, perhaps on cliffs along the coast, and that, like some other indigenous species, it has spread to disturbed places in the Camp area. Certainly it must be native on the isolated, barren, exposed headland on Hicaco Island where I found it growing in December 1945. The species is very widely distributed. (Fl. C. Z. p. 232). *Johnston 755, 866, 936; Erlanson 179.*

Hippomane Mancinella L. MANCHINEEL

A loosely-branched, rounded, wide-spreading tree 6–12 dm. tall, which grows just above the high-tide line on sandy beaches. The trees are numerous and well developed at Playa Grande, especially along the mid-sections and at the north end of that large beach. A colony of them is present at the west end of South Beach. On other beaches of the island, however, the trees are usually present as scattered individuals and are rarely common. They are attractively clad in shiny bright green leaves, give excellent shade on the beaches, and have heavy ascending branches that invite climbing. They could be one of the friendliest of trees if their milky juice were not poisonous and caustic. A drop of its latex from a broken twig or a scratched branch will blister the skin. Smoke from the burning wood is seriously irritating to the eyes. The use of the wood as skewers, while cooking meat on the beach, has been reported as causing severe digestive disturbances, cramps, and diarrhoea.

The leaves are ovate to elliptic-ovate, 3.5–7 cm. long and 2.5–5 cm. broad, and are lustrous above and pale beneath. They are rounded at the base, obtuse or short-acuminate at the apex, and have a margin with minute appressed teeth. The slender petiole is 2.5 cm. long and bears a gland on its upper side near its summit. The flowers are unisexual. The male ones are borne in stiff yellow spikes 5–7 cm. long. The fruits, suggestive of a small green apple, are produced in great numbers. They are not edible. After falling on the beach they are swept away by the tides. They float in the sea, allowing the seeds they contain to be safely transported long distances by ocean currents. In many cases, however, their voyages seem short, for many of them are tossed up on beaches. The old fruits, with their green skins worn away, are the familiar somewhat corky balls, a few centimeters in diameter, which

collect in great numbers in all beach drift, PLATE 11, FIG. 2. The species is distributed along coasts from Mexico and Florida south to northwestern South America. (Fl. C. Z. p. 239). *Erlanson 432.*

Mabea occidentalis Benth.

A shrub or small tree 3–5 m. tall, frequent in the valley of the Rio Marino from the southern end of Little Butch Trail south to beyond Red Hill. It grows inside forests within a hundred yards of the stream and frequently on its banks, always in shady places. The island trees have no latex. The trunk becomes 5–15 cm. thick. The leaves, 8–10 cm. long and 2–4 cm. broad, are somewhat oblong in shape and have an obtuse base and the apex contracted into an acumination 10–15 mm. long. The inflorescence is tassel-like, 5–10 cm. long, 15–20 mm. broad, and red in color. It is borne from November to February and is pendulous or nodding from the tips of the twigs. The 3-lobed capsules, about 12 mm. long and broad, are grayish puberulent and usually stained with purple. The species is known only from Costa Rica and Panama. (Fl. C. Z. p. 239). *Johnston 408, 1053, 1137; Erlanson 162.*

Omphalea panamensis (Beurling), comb. nov.

A large woody climber sending long, coarse stems through thickets and trees along the shore at the south end of Playa Grande and at the north end of Long Beach. I found it only along the coast, but Erlanson has a collection of it labeled as "a woody vine climbing high in the forest canopy in Area 7A, along the West Loop Road." The plant has main stems becoming at least 5 cm. thick. The wood is white and has a central pith 5 mm. in diameter. When cut, the bark oozes a purple sap. The plant is aided in climbing by remarkable giant tendrils which in January 1946 I found being produced in great abundance and making a conspicuous display. Its stems are sympodial, with their sections terminated either by an inflorescence or by a tendril. The tendrils are a meter or more long, whip-like at first, and 5–6 mm. thick below the middle. That they are highly modified stems is revealed by the inconspicuous cuneate, retrorsely deflexed, reduced leaves, 2–5 mm. long, which they bear on their outer, twining half. They project from the plant like whips, slowly alter their position, and eventually touch some support, around which they coil tightly. They never develop their leaves and never branch, and, after functioning for a year or less, appear to die and break off. The plant is essentially a scrambler with coarse elongate shoots. Its tendrils appear to function as a very sturdy, but only temporary support for the tips of its elongate scrambling stems.

The leaves are oblong-elliptic to ovate, 8–20 cm. long and 4.5–14 cm. broad, and are obtuse at the apex and broadly obtuse, or in very large leaves shallowly cordate at the base. The petiole is 1.5–7.5 cm. long and bears a pair of glands at its summit next to the blade. The leaf usually appears to be 3-veined at the base, but actually is 5-veined, with the small outermost veins very close to and obscured by the slightly revolute margin. Only the largest leaves are evidently 5-veined. The leafy stems, 5–10 mm. thick, are tawny and velvety when young but become glabrate in age. The inflorescence, actually terminal on the sections of the sympodial stem, appears to be extra-axillary. It becomes 2–5 dm. long and has spreading branches. Its largest bracts are oblanceolate and only 6–8 mm. long. These panicles produce

abundant male flowers from mid-December at least through May, but I found no developing ovaries and no evidence of fruit during these months. According to the literature, the plant produces a fruit the size of a large orange, which is yellowish and contains three seeds. It is probably matured during the wet season, perhaps towards the close. Unfortunately, when I was on the island at the close of the rainy season during my first visit, I did not meet with the plant and so have no observations on its behavior at that period.

Although no fruits of this plant were encountered, many of its seeds (PLATE 12, FIG. 3) were found washed up on the beaches of Bodega Bay during December 1945 and January 1946. These seeds were not fresh and new, but many had a living embryo and were apparently viable. They gave every evidence of having been part of the drift for at least a month or two. They are nearly circular in lateral outline, usually about 4.5 cm. in diameter and 2.5–3 cm. thick, and have the back convex and the ventral surface either flattened or obtuse and composed of two plane surfaces. Most of them were brown and seemingly velvety. Studied under the microscope they proved to be covered with crowded, minute, vertical plates of tissue, apparently part of a disintegrating seed coat. Scattered here and there in the laminated tissue are numerous black, perhaps glandular, protuberances from the bony seed coat. When very old and worn, the seeds are black. All the brown tissue is then gone, and the surface is minutely and abundantly warted by the protuberances mentioned. Most of the seeds picked up on the beaches during March and April 1945 were in this worn condition. Though not abundant, the seeds of *Omphalea panamensis* are a characteristic part of the drift on San Jose Island. The presence of the vine along the shore and the occurrence of its viable seeds on the beaches give reason for believing that the plant may be disseminated by ocean currents. Guppy, Plants, Seeds & Currents, 159 (1917), reports that the seeds of the very closely related *O. diandra* are found on beaches in the West Indies.

The species is known only from Panama. The name *O. panamensis* is based upon *Hebecocca panamensis* Beurl., Prim. Fl. Portobellensis 146 (1854), described from plants collected "in silvis ad viam versus Panama." Synonymous with it is *O. diandra* var. *panamensis* Kl. in Seeman, Bot. Voy. Herald 101 (1853), described from collections made on Coiba Island. It occurs on both Caribbean and Pacific sides of the Isthmus, inland as well as along the coasts. From true *O. diandra* L., a plant of the West Indies and the Guianas, it differs in having oblong rather than ovate leaves, which are obtuse and not short-acuminate at the apex, and are seemingly only three-ribbed at the base in most cases, and are never decidedly cordate. It differs, furthermore, in having the bracts of the inflorescence always short and the ultimate cymes always glomerate. Its stipules are long persistent and have prominent bases. (Fl. C. Z. p. 238, sub *O. diandra*). *Johnston 599, 720, 1183; Erlanson 110.*

Pera arborea Mutis

A tree frequent in the forests of the island and in some areas locally rather common. It grows 10–20 m. tall, occasionally a bit higher, and has a dusky gray columnar trunk 2–3 or even as much as 6 dm. thick. From a distance the trunk seems rather smooth, but examined closely it is roughened in a distinctive manner by very numerous lenticels. These have corky, swollen margins, and though varying greatly in shape, length, and orientation, many of

them are very suggestive of diminutive human lips. They provide a character by which the tree is easily recognized. Another distinctive character of the tree is revealed by a slash of a machete. Beneath its bark the wood is covered by a slimy film that is mustard yellow in color. The same yellow film is also found under the bark of the root. The leaves, which seem to be renewed about January, are 9–11 cm. long and 3–5.5 cm. broad. They are pointed at both ends and are light green and lustrous above and dull and paler beneath. The trees are unisexual and bear their inconspicuous male or female flowers clustered along their leafy twigs. The fruit is nearly globular, being almost 1 cm. long and slightly less in diameter. It grows in large numbers crowded along the twigs of the plant. When still very young it attains full size. It is then pale green, lightly glaucesent, with empty cells, and, though firm, it may be popped in the fingers. In some cases, at least, parrots are instrumental in causing the fall of immature fruits. In October and November 1944 I found them frequent objects on the forest floor. At maturity the fruit has a hard, bony endocarp. In its three cells are six black seeds, each with a rather large red aril. The exocarp finally dries, darkens, and wrinkles, and the endocarp finally bursts, breaking up into three to six sections and thus freeing the seeds. The sections of the bony endocarp are rather resistant to decay and can usually be found in numbers on the ground beneath the female trees. The period of general fruiting seems to be in November, but there is some scattered flowering and fruiting extending all through the dry season and perhaps on through thre rest of the year. The species is known only from Panama and Colombia. (Fl. C. Z. p. 238). *Johnston 15, 233, 410, 411, 447, 478.*

Phyllanthus antillanus (Juss.) Muell. Arg.

A small tree 4–9 m. tall, apparently rare on the island. A few individuals grow under the palms at OrangeTree Beach, more along the bank on the landward side of the Playa Grande mangrove swamp, and others at the margin of the swamp forest at the mouth of the Rio Marino. In addition to the couple of dozen trees seen at these three places, two more were found near the north corner of Area 11B in a forest on the ridge along the trail west from Bald Hill. The tree has a gray, rather smooth trunk and branches, but reddish twigs. The lanceolate leaves are 6–13 cm. long, 2–4.5 cm. broad, and pale beneath. The trees at OrangeTree Beach had passé male flowers on December 28, 1945, but shed them during the next fortnight. No fruit was developed. The trees at other localities were first discovered in January and were all sterile. The period for flowers and fruit is probably during late November and early December.

The species is widely distributed in tropical America. It has been generally called *P. nobilis* (L. f.) Muell. Arg. That name, however, is based upon *Margaritaria nobilis* L. f. (1781) which must be rejected, since it was founded on a mixture that included not only material of the present species but also some representative of the *Combretaceae.* The next available name is *P. antillanus* (Juss.) Muell. Arg., founded upon *Cicca antillana* Juss. (1824). The latter appears only on a plate showing floral analyses, but these, taken in conjunction with Jussieu's discussion of the genus, are sufficient to identify the plant concerned. Miquel, Linnaea **21: 479** (1848), who published the next available name, *Cicca surinamensis,* accepted Jussieu's name as ade-

quately published, and I am content to do likewise. (Fl. C. Z. p. 233, *P. nobilis*). *Johnston 954, 1251, 1297, 1364.*

Phyllanthus carolinensis Walt.

A small, slender-stemmed herb growing on thin soil areas at East Harbor. It appears during the rainy season and seems to be uncommon. The species is widely distributed in America. (Fl. C. Z. p. 233). *Johnston 185; Erlanson 443; Harlow 78.*

Phyllanthus diffusus Kl.

A small, slender-stemmed herb growing in areas of thin soil near East Harbor and as a rare weed in one section of lawn at Main Camp. I believe that the plant is native on the island.

The species is known from Panama and northern South America. It differs from the following species, *P. Niruri*, in having seeds less strongly ridged on back and sides, in having broader sepals, and in having more slender ascending, rather than divaricate, branchlets. (Fl. C. Z. p. 233). *Johnston 184, 1004.*

Phyllanthus Niruri L.

A small, slender herb locally abundant on the fill along Red Hill Grade in January 1946. Like a number of the weedy plants with which it grew, it is probably a recent immigrant from the Isthmus. The species ranges widely in the tropics of both hemispheres. (Fl. C. Z. p. 233). *Johnston 1315.*

Phyllanthus Urinaria L.

A weed well established and common in the lawns at Main Camp in December 1945. The species is native in the Old World but is now widely spread as a weed in tropical America. (Fl. C. Z. p. 233). *Johnston 899.*

ANACARDIACEAE

Anacardium excelsum (Bertero) Skeels Espavé

A giant tree which, though not very abundant on the island, is conspicuous because of its great height and massive trunks. It is usually found along streams, frequently at the water's edge, but on Red Hill grows in forests on springy slopes. Along the stream in Area 11B and on the western slopes of Red Hill it is locally rather common. Over most of the island, however, it usually grows scattered, with considerable distance between individual trees. The tree is usually 20–30 m. tall, but may occasionally become even a little higher. Its crown tends to be more high than broad. Most individuals have a giant columnar trunk 1–2.5 m. thick that may rise 10–15 m. without a branch. Massive roots spread from the base of the trunk, usually only half buried in the surrounding soil; very frequently they cross and partially dam the stream near by. Some trees become very large. One near the road in Pump Valley, though only about 20 m. tall and branching a mere 3–4 m. above the ground, has a trunk 3 m. thick, breast high, and huge exposed roots, of which some are 5 dm. thick at 3 m. from the tree. The bark on old trees scales off in coarse plates. The herbaceous epiphytes, orchids, ferns, bromeliads, etc., thrive on the tree, clinging here and there on its trunk and forming gardens on its ponderous spreading branches. Epiphytic trees such as

Coussapoa, Ficus, Souroubea and *Clusia* frequently grow in its crown and send their roots down along the great trunk. Though they may master other lesser arboreal growth, they are rarely more than a nuisance to this giant tree.

The leaves are oblong-obovate, 15–28 cm. long and 6–12 cm. broad, broadest well above the middle. Their base is acute and their apex rounded or even emarginate. They are glabrous and have 12–22 pairs of strong, nearly parallel veins. Leaf renewal occurs during January and February. The individual flowers are inconspicuous but are borne in light-colored, loosely branched inflorescences about 3 dm. long which project from the leafy crown of the tree in great numbers and so become conspicuous. These inflorescences appear in February. During March, April and May they bear the distinctive fruit of the tree. This is an asymmetrical, biconvex, elongate nut 3–3.5 cm. long, nearly 1 cm. thick, and 2 cm. broad below the middle. It is borne on a thickened accrescent pedicel that is somewhat fleshy, sigmoid, 2–3 mm. thick and 1.5–2 cm. long. The nut is filled with a large oily seed much relished by parrots. Most of the crop is eaten by these birds, much of it before full maturity. The species ranges from Nicaragua to Panama, Colombia, and Venezuela. (Fl. C. Z. p. 242). *Johnston 127, 536, 649.*

MANGIFERA INDICA L. MANGO

At Mango Beach, located in the bight just south of Playa Grande, a small mango tree, a calabash, and some banana plants grow at the head of the beach. They were evidently planted about a dwelling formerly located there. Since other points of settlement on the island might supposedly be marked by old mango trees, every effort was made to discover such trees, but no others were located. The species originated in southeastern Asia and is now widely cultivated in the tropics. (Fl. C. Z. p. 241).

Spondias Mombin L. JOBO, HOG PLUM

A tree usually 10–20 m. tall with a cylindrical trunk 2–5 dm. thick. On San Jose it appears to favor places where rock outcrops offer a secure anchorage for the roots. It is frequent on thin soils as part of the deciduous forest on the eastern peninsula, and is occasional in evergreen forest in all parts of the island, and sometimes, as about Bald Hill and in parts of the Camp Valley Forest, is locally rather common. One tree on Bald Hill is fully 27 m. tall and has a trunk 8–9 dm. thick. It has two types of bark which could not be correlated with either age or habitat. Some trees have a rather smooth, thick bark that is red and laminated in section. On most trees, however, the trunk is coarsely furrowed. In section the inner part of the bark is pale, while the outer furrowed part is hard, brown, and more conspicuously laminated. Along some roads numerous young trees have appeared in the second growth. Some between Main Beach and Headquarters, having had two growing seasons, were by January 1946 4.5 m. tall and had trunks 1 dm. thick.

The leaves are pinnate and bear 9–15 leaflets on a rhachis 15–30 cm. long. The leaflets, 8–13 cm. long and 3–4.5 cm. broad, have a coarsely acuminate tip and a base that is acute, oblique, and asymmetrical. They have petiolules 5–10 mm. long. The foliage is shed during January and not renewed for several weeks. The minute yellowish flowers are produced in loosely branched inflorescences 2–4 dm. long which project from the ends of the leafy branches.

During March and early April the trees, freshly clad in new leaves, bear great numbers of these flower clusters and become very conspicuous for a few weeks. The orange-yellow plum-like fruit, 2.5–3 cm. long and 17–20 mm. in diameter, matures during the wet season and consists of a tart, edible flesh surrounding a fiber-coated stone. It is produced in such abundance that the fiber-coated, ellipsoidal stones which have accumulated under the trees and can be found there at all seasons serve as an aid in identifying the tree. There are many reports from the tropics that wild pigs are especially fond of the fruits, but so far as I could determine the pigs of San Jose showed no particular preference for them. The dry, fiber-coated stones are apparently washed into streams and carried to the sea, PLATE 11, FIG. 3. They are one of the common fruits in the beach drift in the West Indies and can be found very frequently on the beaches of San Jose. The species is widely distributed in tropical America. (Fl. C. Z. p. 241). *Johnston 154, 746; Erlanson 286, 596.*

Spondias purpurea L. var. **munita,** var. nov.

A varietate typica differt, ramis vetustioribus et trunco spinas conspicuas rigidas validas 5–10 cm. longas ad 5 mm. crassas gerentibus; ramis elongatis sparsissime breviterque ramosis erectis vel divaricatis; foliolis minute sed distincte serratis; inflorescentia rubra laxe 5–10-flora haud ramosa 15–25 mm. longa 5–8 mm. diametro; floribus rubris 2.5–3 mm. longis; fructibus ellipsoideis rubris ca. 2 cm. longis.

TYPE: *Johnston 573,* San Jose Island, a shrub sprawling over rocks on the crest at Max Point, March 29, 1945.

A shrub or small tree, less than 5 m. tall, which grows in places with thin soil. Scattered plants are found here and there in patches of deciduous forest on areas with thin soil, on the eastern peninsula. Elsewhere on the island it was seen at the summit of Max Point and on one of the islets along the coast near Main Beach. Its habit of growth varies. Most plants have a small trunk, 5–10 dm. long and about 1 dm. thick, producing a few elongate, sparingly branched, ascending stems. At Max Point the plant sprawls over the rocks on the crest. One large tree in the forest near East Harbor had a very peculiar habit. From the top of an erect trunk 9 dm. tall, the branches all spread horizontally, reaching 2–4 m. in length, with some so very elongate that they managed to maintain a horizontal position only by resting their tips on adjacent vegetation. The branches and trunks, whether erect, horizontal, or sprawling, always bore coarse stiff woody spines 5–15 cm. long. These spines were short-shoots, which functioned for a time as stout, divaricate, leafy twigs, and then became spinescent. The pinnate leaves bear 7–21 leaflets. Their rhachis is 15–25 cm. long, very narrowly winged on the margin, and bisulcate above. The leaflets, 2–4.5 cm. long and 1–1.7 cm. broad, are acute and asymmetric at the base and rounded to acute at the apex. They are hairy on the petiolule (0.5–1.5 mm. long) and midrib beneath, especially when young. There is a very distinct submarginal vein. Their margin is finely but distinctly toothed, the teeth having short aristate tips. The plant sheds its foliage in January and flowers during February and March before renewing its leaves. The inflorescence is bright red and borne on old wood. It is racemose, 5 cm. long or less, and produced singly or in loose clusters of 2–6. The small flowers are colored like the inflorescence. The juicy red

fruit is plum-like, about 2 cm. long and 15 mm. in diameter, and has a good flavor. Its stone resembles that of the previous species but is smaller in size.

The variety is known only from Panama and is an indigenous plant. It differs from the cultivated *S. purpurea,* a native of the West Indies, in its distinctive growth form, spinescent twigs, serrate leaves, loosely flowered, racemose, bright red inflorescence, smaller bright red flowers, and smaller bright red drupes. *Johnston 573, 787, 964, 1410.*

SAPINDACEAE

Allophyllus occidentalis (Sw.) Radlk.

A shrub or rarely a small tree 2–8 m. tall, occasional in thickets and in open forests on the northern half of the island. It is most abundant about forest margins on Bald Hill and in openings in the forest on the eastern peninsula, and least common on the western side of the island. On the southern half of the island it was seen only on a thin soil area back of Mango Beach.

The compound leaves are composed of three leaflets which have a toothed margin and are soft hairy and usually grayish beneath. The middle, largest leaflet is 10–18 cm. long and 5–9 cm. broad. The plant sheds its foliage in March or late February. For a month or so it remains leafless but is nevertheless rather conspicuous because of the plump, gray, felt-covered buds, 2–4 mm. in diameter, borne in numbers along its branches. The foliage is renewed and the inflorescences are developed in May. The small white flowers are borne crowded in dense, racemose panicles 2–5 cm. long and 7–10 mm. thick. The fruit, matured in June and July, is orange-colored, subglobose, 5–6 mm. in diameter, and contains a single seed within its thin shell. The seed coat is hairy. The species is known from the West Indies, northern South America, and western Central America. (Fl. C. Z. p. 246). *Johnston 590, 1055, 1258, 1305; Erlanson 98, 154, 231, 292, 372, 387.*

Cupania fulvida Tr. & Planch.

Occasional on the northern and eastern parts of the northern half of the island. Present at times as a forest tree 10–15 m. tall, but most common as a bushy tree 3–6 m. tall in high thicket. A characteristic individual of the species may be seen at the northeast corner of the intersection of the West Loop and Dead End Road. Wherever the plant occurs it stands out among other vegetation because of its somber brownish hue. This is the result of an abundance of coarse brown hairs that give a dense velvety coating to its twigs and, in less degree, to its foliage also. The coarse pinnate leaves usually have 5–7 crowded leaflets alternating on the rhachis and gradually increasing in size as they are borne farther out on it. The outermost leaflets are usually 1–2 dm. long. They are obtuse or rounded at the apex, have numerous strong paralleling primary veins, and are brownish velvety, particularly so when young. The white flowers are borne crowded in dense, coarse, racemose clusters in a brown, velvety, usually branching inflorescence. The fruit is a strongly and sharply three-angled hairy pod 15–20 mm. broad. The plant starts flowering in January and is through fruiting in April. The species is known from Panama and adjacent Costa Rica. (Fl. C. Z. p. 246). *Johnston 571, 542, 1337.*

Matayba glaberrima Radlk.

A bush or small tree most abundant among dense vegetation near the coast, particularly on headlands, on wooded islets, and along the summit of sea cliffs. It is also frequent in open forests, margining the thin soil areas on the eastern peninsula. It was found in the center of the island only about thin soil areas in Area 7C. The plant grows 2–8 or rarely 12 m. tall, and commonly has several trunks 5–10 cm. thick, covered with a tight, pale gray, rather smooth bark. The pinnate leaves have 4–5 leaflets alternating on the rhachis. The leaflets are almost glabrous and are entire-margined. The largest ones are 8–15 cm. long and 3–7 cm. broad. The hairy white flowers have conspicuously exserted stamens and a corolla 3–4 mm. broad. They are borne in short crowded racemose clusters and appear during April and May. The fruiting plant has not been collected on the island. The species is known only from Panama. (Fl. C. Z. p. 246). *Johnston 225, 709, 731, 792; Erlanson 81.*

Serjania atrolineata Sauv. & Wright

A vine with hair-spring tendrils which is frequent in thickets on all parts of the island. Its main stems are 1–2 cm. thick and rather flexible. They apparently die back to the ground each year. When cut they ooze small amounts of milky sap. The stems and twigs are rounded, smooth, generally reddish or brownish, and usually ornamented by three pairs of longitudinal grooves. Their wood structure is distinctive. There is a triangular central mass of wood laid down about a small triangular pith, and just outside of it and separated by phloem are three other cylinders of wood, one lying along each of its flattened sides. This composite wood structure is evident even in small twigs. In the larger stems, where the outer masses of wood change from elliptic to somewhat plano-convex in cross section, it is very conspicuous. The three sets of longitudinal grooves that decorate these large stems occur between adjacent lateral masses of wood and directly over the angles of the central one.

The leaves are compound, consisting of three sets of three leaflets. Including the petiole they are usually 5–12 cm. long, but on main stems may reach 28 cm. in length. The nine leaflets are firm, dark green above, pale beneath, and irregularly and sparsely sinuate-dentate above their middle. They may have a few minute hairs along the midrib but are otherwise glabrous. Viewed under a lens their under surface is decorated by numerous irregular very slender purple lines. The leaflets are usually 2–5 cm. long and 8–30 mm. wide but, exceptionally, can become as much as 12 cm. long and 5 cm. wide. The flowers, borne in stiff racemes 5–8 cm. long, are produced in great numbers. The racemes, covered with grayish buds, become conspicuous in February. The chief period of flowering is late in February and early March. The fruit becomes conspicuous towards the end of the latter month and continues present through April. It is cordate in outline and consists of three broadly winged parts 2–3 cm. long and 17–22 mm. wide. The wings are straw-colored or, more commonly, red or purplish. The thick, seed-bearing end is 3–4 mm. thick, dark, prominently veined, and evidently short hairy. The species is found in Cuba and from southern Mexico to Panama. (Fl. C. Z. p. 244). *Johnston 517, 663, 696, 710, 1405, 1413; Erlanson 26, 180.*

Serjania rhombea Radlk.

A vine with watch-spring tendrils and a very distinctive stem which was found only along the trail between Areas 8A and 8B, a short distance north of East Road. It was local in dry forest, margining thin soil areas and climbing over treetops. The main stems are flexible, dusky in color, and covered by a bark that is roughened by numerous minute, corky lenticels. They are distinctly three-sided with the edges rounded and the sides, which become 2 cm. broad, coarsely 2–3-ribbed. When cut they are revealed to be composed of four distinct cylinders of wood, a central one and three other slightly smaller ones arranged at equal distances about it and projecting from it to form the angles of the stem. Each of these cylinders is surrounded by phloem.

The leaves are light green, sparsely hairy and dark above, and below pale and velvety to the touch because of an abundance of short, soft hairs. They are triangular in outline, 10–15 cm. long, and bear 9 leaflets. The leaflets, borne in sets of three, are coarsely and deeply sinuate at the margins and 3–9 cm. long and 2–7 cm. broad. They are noticeably thinner and less coriaceous than those of the other *Serjanias* on the island. The plant was first discovered in February 1946, when it was growing vigorously but showing no evidence of flowering. The species ranges from Nicaragua to northwestern South America. (Fl. C. Z. p. 244). *Johnston 1411.*

Serjania nesites, sp. nov.

Frutex scandens; ramis foliatis prominenter 4–6-costatis profunde 4–6-sulcatis aculeatis sparse minuteque hispidulis vel glabratis saepa 3–8 mm. crassis valde elongatis corpore lignoso simplici donatis; foliis imparipinnatis 19–21-foliolatis jugis 3–4 donatis in ambitu deltoideis saepe (petiolo inclusis) 2–3 dm. longis rariter ad 4.5 dm. longis; jugo infimo folii saepissime 5-foliolato et pinnato, secundo palmate 3-foliolato, reliquis unifoliolatis; rhachi primario folii inter jugis conspicue 3–6 mm. lateque alato; rhachibus et petiolulis jugorum alatis; petiolo primario 4–9 cm. longo inermo vel sparse aculeato; foliolis sessilibus saepe 4–9 cm. longis et 2–5 cm. latis rariter ad 15 cm. longis et 9 cm. latis oblongis vel ovatis, basi acutis vel obtusis, apice breviter lateque acuminatis, margine supra medium sparse grosseque sinuato-dentatis, supra viridibus subnitidis juventate sparse minuteque hispidulis mox glabratis, subtus pallidioribus minute inconspicueque hispidulis; inflorescentiis terminalibus ramosissimis efoliatis 2–4 dm. longis, axillaribus quam foliis longioribus vel subaequilongis; pedicellis gracilibus 1 mm. longis, fructiferis saepe 2 mm. vel rariter ad 3 mm. longis; sepalis inaequalibus 2–3 mm. longis liberis dense minute pallideque tomentulosis; petalis 2.5–3 mm. longis 1.2–1.6 mm. latis oblanceolatis; squamilis ca. 1.5 mm. longis; staminibus pilosis; fructu in ambitu cordato vel angusto cordato 17–20 mm. longo 12–17 mm. lato, parte seminifero ad 4 mm. longo ca. 3 mm. lato et 2 mm. crasso glabro sublaevo perinconspicue elevato-venoso.

TYPE: *Johnston 707,* San Jose Island, along South Road about a half-mile from the beach, vine on thicket.

A woody vine with hair-spring tendrils that grows in thickets and climbs high in trees in open mixed forests and along forest margins. It is frequent in all parts of the island. At the beginning of the dry season it starts vigorous growth and continues it through February. The elongate brown or reddish stems are prominently ribbed, usually armed with numerous small thorns, and commonly 5–8 mm. thick. The compound leaves are deltoid in

outline, composed of 19–21 leaflets, and usually 2–2.5 dm. broad. The rhachis between the segments has conspicuously winged margins. The small white flowers are borne in racemes that are aggregated into branched panicles at the ends of the branches. These panicles are conspicuous during March when bearing the flowers, and again in April when loaded with the winged fruit. The fruit is cordate in outline and consists of three winged parts.

Among the San Jose species of *Serjania* this is the only one with simple stem structure. The larger leaf-bearing stems and shoots have a large pith which is irregular and has an angulate outline in cross section. Surrounding it and having a similar outline is an unbroken band of wood 0.5–1 mm. thick. There are no bits of xylem in the bark to become conspicuous secondary centers of wood development, such as are present in the leafy stems of the other island species. The structure of the stems of our present species is very similar to that of comparable stems of *S. mexicana*. It represents what Radlkofer calls a "corpus lignosum simplex." Though the young stems have a simple organization of their wood, they do show some slight complications in later development. As the wood thickens a set of three diverging rays develops from each of the usually five angles of the pith. The outer rays of each set roughly parallel the outer rays of the sets adjacent to it. The wood, in cross section, accordingly, is marked off by the rays into five pairs of triangular areas that alternate with five areas oblong in shape. Though seldom developing symmetrically, this basic pattern is discernible in all large stems. Examination of the stems also shows that the wood is laid down more rapidly in the triangular sectors than in the oblong ones. The slower rate in wood formation in the oblong sectors is compensated by excess development of their phloem, which gives the impression that the bark has intruded upon them. This intrusion of phloem into the woody cylinder is the only unusual development exhibited by the old stems. In stems 2–4 cm. thick the intrusions are straight-sided, 2–4 mm. broad and fully as deep. Similar behavior of phloem is well known in the stems of *Bignoniaceae*, but I have not found anything similar described for *Serjania*. Some large stems of our plant have coarse thorns, but the largest ones have rough, furrowed bark and are unarmed. They are usually obscurely pentagonal and may reach 4 cm. in diameter. When cut they ooze some milky latex.

The species is known only from San Jose Island. It is related to *S. mexicana* Willd., but differs in having much larger deltoid leaves with very numerous leaflets and pinnae. The lower pair of pinnae of the leaves are pinnately 5-foliolate. At least two internodes of the primary rhachis are conspicuously winged as is at least one on each of the two lowest pairs of pinnae. The flowers average a bit smaller than those of *S. mexicana*. The fruits, however, seem indistinguishable. *Johnston 507, 547, 550, 665, 700, 701, 707, 712, 912, 962; Erlanson 27, 113; Campbell 6.*

ICACINACEAE

Calatola

Stones of the fruit produced by this genus of tropical trees are not uncommon in the beach drift in Bodega Bay. They are weathered and completely clean of the thin pulp originally covering them. All are hollow, the large seed they formerly contained being long dead and completely disintegrated.

They are ellipsoidal in form, 5.5–6 cm. long and 3–4.2 cm. in diameter, and roughened by narrow, prominent ridges and cross-ridges in a rather variable pattern. I found examples of the fruit on E. M. Beach, Main Beach, Englishman Beach, Observer Beach and Long Beach, well over a hundred of them, at one time or another during my visits on the island. A sample lot of six were kept as museum specimens. These latter were shown to Dr. Richard Howard, who has made a study of this genus. He reports that one of them (PLATE 10, FIG. 2) is very similar to the fruits associated with herbarium material of *C. venezuelana* Pittier, collected in the highlands of Venezuela, Peru and Colombia. The remaining five of the sample lot (PLATE 10, FIG 1) agree with fruits associated with herbarium material of *C. costaricensis* Standley, a species now known only from the highlands of Costa Rica and from northwestern Panama. Neither of the two species mentioned is now known from the islands or coast of the Gulf of Panama nor from the western coast of Colombia, where the drift washed up on San Jose Island presumably originates.

CELASTRACEAE

Elaeodendron xylocarpum (Vent.) DC.

A tree growing on or near the coast of the southern half of the island. It grows back of the Physiological Laboratory on the cliff overhanging the mangrove swamp, on the cliffs along the bay west of OrangeTree Beach, with palms on Long Beach, on the sea cliffs at the Garbage Dump, on cliffs along Navy Cove, and on the cliffs at Mango Beach. The finest stand of the tree grows on the sandy terrace, with *Hippomane* and *Manilkara*, at the west end of South Beach. Away from immediate proximity to the ocean the tree was seen only in the forest back of the Navy Station. On cliffs it is frequently a small tree 2–3 m. tall, but on beaches it may become 3–15 m. high and have a trunk 1–3.5 dm. thick. The trunk tends to be somewhat elliptical rather than circular in cross section, and its smooth gray bark usually is very conspicuously splotched with crustose lichens. The leaves are firm, light green, frequently nearly opposite, 8–15 cm. long, 3.5–7 cm. broad, and usually sinuate-toothed on the margin. They are glabrous and their surface has a fine reticulum of prominent veinlets. They are renewed in January. The small yellowish flowers have white petals and are borne in stiff-branched inflorescences 2–3 cm. long, produced along leafy twigs. When ripe the fruit is ellipsoidal, about 3 cm. long and 2 cm. in diameter. It has a thin, slightly yellowish flesh surrounding the large hard stone. The species seems to have its chief period of fruiting at the close of the rainy season. In October and November 1944 I found most of the trees maturing fruit. In January and February 1946 one plant was seen in flower and another in fruit, but most plants were sterile and were renewing foliage. In late March 1945 fruiting plants were not uncommon. Erlanson collected flowering and fruiting specimens on the island at the last of July 1945. It seems probable that the species flowers and fruits several times a year.

The species is a very variable one, widely distributed in the West Indies but apparently rare and local on the adjacent continent. Plants determined as this species have been reported from northwestern Mexico and from Yucatan, but not elsewhere in Mexico or Central America. The San Jose Island tree seems indistinguishable from the form of the species found in the

Lesser Antilles which has been separated as the variety *caribaeum* Urb. *Johnston 113, 290, 294, 412, 532, 1094; Erlanson 84, 521, 522.*

HIPPOCRATEACEAE

(Identifications by A. C. Smith)

Elachyptera floribunda (Benth.) A. C. Smith

A woody vine growing on mangroves near the Goat Barn, on the forest margining the mangrove swamp near OrangeTree Beach, on the forest on Punta del Cabo and on beach thickets and forests at South Beach. It is most abundant on Punta del Cabo, where it is one of the principal lianas in the forest of *Manilkara* and *Pouteria* on that headland. Its stems become 6 cm in thickness. They are easily recognized, for when the bark is scraped a layer of cinnabar red is revealed just under the smooth, dusky bark epidermis. The plant is aided in its climbing by specialized twigs which wrap themselves once or twice about supporting branches. The opposite leaves are lanceolate and entire-margined. They are 7–13 cm. long and 2–5 cm. broad. The very small greenish white flowers are borne in very much branched panicles in which the twigs and main axes are distinctly quadrangular. The fruit is a flattened or somewhat biconvex pod 4–5 cm. long, 2–2.5 cm. broad, and 3 mm. thick. The principal period of flowering seems to be during the first half of the wet season. The species ranges in Central America and northern South America. *Johnston 484, 1128, 1159; Erlanson 393, 523, 562.*

Hylenaea praecelsa (Miers) A. C. Smith

A large woody vine curtaining the forest margin just south of the mangrove swamp at Playa Grande and growing over the trees on the forested sea cliffs east of Area 8D. The plant is tied to its support by specialized twigs which wrap themselves once or twice about a supporting branch. The lustrous leaves are opposite and usually 10–18 cm. long and 4.5–7 cm. broad. The minute greenish flowers are borne in very much branched dichotomous panicles produced in the leaf-axils. At Playa Grande they were being produced in great numbers during late January and February. No fruit was seen on the island. The fruit is a woody capsule said to be obovate in form and 7.5 cm. long, 4–8 cm. broad, and 1–2 cm. thick. The species is restricted to Panama. Until collected on San Jose it was known only from the Canal Zone. (Fl. C. Z. p. 243, sub *Salacia praecelsa*). *Johnston 1220.*

Hippocratea volubilis L.

A slender, woody vine frequent on thickets and on forest margins in the southern half of the island. The plant has its period of vigorous growth in January. It sends out elongate, slender shoots which branch and grow to some length before the leaves enlarge. The branches wrap about a support in a half hitch, thus aiding the plant in climbing. Most growth is over by mid-February when flowering begins. The opposite, oblong or elliptic leaves are 8–10 cm. long and 4–6 cm. broad. They are pale green and have a more or less sinuate margin. The yellowish flowers are 6–7 mm. broad, borne in a loosely forking, flat-topped, axillary panicle. The inflorescences are borne in great numbers and make the plant conspicuous for a time in March and April. The fruit is a biconvex capsule 4–8 cm. long, 1.5–4 cm. broad,

and 2–5 mm. thick. One to three are matured by each flower. The species is widely distributed in tropical America. (Fl. C. Z. p. 243). *Johnston 529, 605, 739, 1143.*

AQUIFOLIACEAE

Ilex guianensis (Aubl.) Kuntze

One of the common forest trees on the southern half of the island. It is uncommon and local on the northern half of San Jose, being seen there only at the south end of the West Loop, between the Cross Roads and Red Hill, in the vicinity of Bald Hill, and along the northern parts of the Loop, particularly between Bald Hill Road and Dead End Road. The tree generally grows with *Ternstroemia* and *Cassipourea.* It usually grows 5–15 m. tall and has a trunk 1–2.5 dm. thick. The largest individual seen was nearly 18 m. tall and had a trunk 6 dm. thick, breast high. When the rather smooth and pale bark on the trunk is lightly scraped, a bright green layer is revealed just beneath the thin whitish bark epidermis. The leaves are oblanceolate, 5–10 cm. long, 2–4 cm. broad, and acute at the apex. They are thickish, dull, dark green above, and beneath olivaceous and inconspicuously veined. The petiole is 6–9 mm. long. Leaf-renewal occurs in January. The white flowers, 4 mm. broad, are borne in crowded clusters along the leafy twigs. Flowering is most abundant and general early in the wet season (June and July). The chief period for fruiting seems to be about the end of the wet season. Occasional trees in flower or fruit, however, can be found at other seasons. The fruit is globose, dark purplish or black, and very juicy when ripe. It becomes 5–6 mm. in diameter at full maturity and is borne in great abundance along the leafy twigs. The species is known only from Central America and northern South America. *Johnston 224, 338, 341, 426, 428; Erlanson 77, 260, 348, 411, 513; Harlow 95.*

RHAMNACEAE

Colubrina glandulosa Perkins

A rare tree of open forests. It becomes 15 m. tall and develops a trunk 55 cm. in thickness. The bark on large trunks scales off in corky, elongate flakes 5–20 cm. long and 2–5 cm. in width. Large trees are rare; less than a dozen were seen on the island. A few were located along South Road west of Area 3D, others in Area 8B, and one on the Jeep Trail west of the Bald Spot. In January 1946, however, a goodly number of young trees were recognized. These were bushy in form and 2–4.5 m. in height and were growing in disturbed places near roads in Area 3A, on Mango Beach Jeep Trail, near the Motor Pool, at the south end of the West Loop, and at several places along the East Loop. The species is evidently increasing in abundance as a result of Army activities on the island.

The leaves are glabrous, ovate to elliptic, dark green and glossy above, pale and dull beneath, 10–18 cm. long and 5–11 cm. broad. On the obtuse or slightly cordate base there is a pair of conspicuous glands close to the petiole. The inflorescence, clothed in rust-colored hairs and produced along the leafy twigs, is a much branched cyme 1–2 cm. long. The small yellow flowers first appear in January. The fruit is a rounded capsule 7–9 mm. in diameter. It matures in February, March, and April, when it breaks up and frees three small shiny black seeds.

I first discovered this species on the island in mid-April 1945. At that time the trees were devoid of leaves and giving no evidence of soon replacing them. Their naked twigs, however, bore clusters of completely ripe, dehiscing capsules in great abundance. During January and February 1946 trees were observed in flower and maturing fruit. All were well clad in their handsome lustrous foliage. They were neither putting forth any new growth nor giving any evidence of imminent leaf-fall. These observations, though very incomplete, seem to indicate that the tree sheds its foliage after ripening its fruit and that it may remain leafless for some time after the middle of the dry season.

The species ranges from Panama to Peru and Brazil. In the past it has been confused with *C. rufa* (Mart.) Reiss. That species of Brazil, however, is more closely related to the West Indian *C. ferruginosa* Brong., and differs from our tree not only in its much larger rufous flowers, but also in its very hairy leaves lacking in basal glands. (Fl. C. Z. p. 248, sub *C. rufa*). *Johnston 742, 1018, 1363.*

Gouania polygama (Jacq.) Urb.

A common, slender-stemmed woody vine growing in thickets and forests on all parts of the island. The plant has hair-spring tendrils and its stems and lower leaf surfaces are clothed in abundant short, soft, pallid hairs. Its main stems, covered with grayish, furrowed bark, become as much as 5 cm. in diameter. The leaves are elliptic to ovate-oblong, 6–10 cm. long, 2.5–5 cm. broad, obtuse or somewhat cordate at the base, and distinctly sinuate on the margin. The very small white flowers are crowded in large numbers in slender, spikelike inflorescences 5–15 cm. long, which are produced in great numbers and first become conspicuous during December. The dry fruit is three-winged, straw-colored, 6–10 cm. broad, 3.5 mm. high, and at maturity breaks up into three parts, each with a diverging pair of broad lateral wings. The plant fruits abundantly during most of the dry season. The species is widely distributed in tropical America. (Fl. C. Z. p. 248, plate 46). *Johnston 514, 619, 906, 1173; Erlanson 18; Andersson.*

VITACEAE

Cissus erosa L. C. Richard

A vine with thickish trifoliate leaves and tendrils, growing on thickets and forest margins. It is very similar to *C. rhombifolia* but usually does not become such a large plant nor climb so high. The under surface of its foliage is glabrous, lustrous, and roughened with a fine reticulum of prominent veins. The middle leaflet is 5–10 cm. long, 3–4.5 cm. broad, and is contracted into a sessile base. The inflorescence is red, flat-topped, 3–8 cm. broad, and bears an abundance of small red flowers. The flower clusters are produced in abundance, and when the plant is in full flower make it attractive and conspicuous. The fruit is grape-like, black, and 6–9 mm. in diameter. The species ranges from Mexico to northern South America. (Fl. C. Z. p. 249, sub *C. salutaris*). *Johnston 429, 885, 976; Erlanson 68.*

Cissus rhombifolia Vahl

A common vine with trifoliate leaves and tendrils, which climbs high on trees and frequently on thicket also. The under surface of the foliage is dull and bears scattered coarse hairs along the midrib and the only moderately

prominent veins. The middle leaflet is 6–16 cm. long, 4–10 cm. broad, and is gradually contracted at the base into a distinct petiole 6–15 cm. long. The inflorescence is red, 3–10 cm. broad, flat-topped, and bears abundant small red flowers. These showy red flower clusters are produced very abundantly, and at the close of the rainy season become very conspicuous and decorative along forest margins. The grape-like berry is depressed globose, lustrous black, very juicy, and 6–9 mm. in diameter. The species ranges from Mexico south into South America. (Fl. C. Z. p. 249). *Johnston 973; Erlanson 193; Harlow 11.*

Cissus sicyoides L.

Frequent in areas of thin soil, particularly on the eastern peninsula, and on exposed cliffs, rocks, and islets along the coast. Its stems commonly creep over the soil and show little inclination to climb, but occasionally they are to be seen climbing high in large deciduous trees. The plant is entirely glabrous. Its leaves are simple, thickish, slightly fleshy, and cordate, and are commonly 4–7 cm. long and 4–6 cm. broad, but occasionally as much as 13 cm. long and 10 cm. broad. They are sharply but not very conspicuously toothed on the margin, darkest above and minutely roughened by a fine reticulum of prominent veinlets. The petiole is 2/5–1/2 as long as the blade. The inflorescence and flowers are either greenish or reddish. The fruit at maturity is black, strongly depressed-globose, and 5 mm. long and 8 mm. in diameter.

The species is a variable one widely distributed in the American tropics. The San Jose plant differs from the true *C. sycioides* of Jamaica in leaf form. It is, however, the same as a glabrous plant with thickish, prominently veined, cordate leaves which has been collected on the Pacific coast of Panama (including Taboga Island) and in northern Colombia. This form has never been differentiated and named. *Johnston 940, 1126; Erlanson 103, 334.*

Cissus

A coarse vine with thickish juicy stems, climbing on forest margins. The light grayish green leaf blades are ovate to cordate in general outline but always distinctly triangular where they join the petiole. They are 7–14 cm. long, 4–14 cm. broad, rather juicy, and beneath inconspicuously puberulent along the veins. The petioles are also puberulent and usually about half as long as the blades. The flowers are yellowish and borne in loosely branching, flat-topped inflorescences 8–15 cm. broad. The ripe fruit is greenish black.

This is one of the very diverse plants that has been treated as a form of *C. sicyoides*. It is, however, obviously distinct from the plant of San Jose Island which I have referred to that species. It has been collected in the Canal Zone (at various times on Barro Colorado Island) and also in northern Colombia (e. g. H. H. Smith no. *1625* from Santa Marta) and may possibly be the plant of "Panama" described as *C. obtusata* Benth. (Fl. C. Z. p. 249, sub *C. sicyoides*). *Johnston 875.*

Vitis tiliaefolia H. & B. WILD GRAPE

A vine with the habits and general appearance of the cultivated and wild grapes of the United States. A distinctive feature of the plant, however, is the tan or frequently orange-rufous coating of matted hairs that clothes the young shoots and the lower surface of its leaves. The vine is not common

on San Jose. It was seen at only four places on the island, in the western parts of Area 8B, along the middle western boundary of Area 8C, at the western corner of Area 8D, and on the headland near the lookout at the mouth of Bodega Bay. At these four stations it was climbing over thicket, and was local. Elsewhere in Central America the vine is said to reach giant size and to develop very large main stems, but on San Jose it was not particularly vigorous. The largest stems found measured only 6 cm. in diameter. The plant was not found in flower nor fruit on the island. The species ranges from Mexico and the West Indies south into northern South America. (Fl. C. Z. p. 248). *Johnston 591.*

TILIACEAE

Apeiba Tibourbou Aubl. PEINE DE MICO

A tree 6–18 m. tall, locally frequent at forest margins and in open forests back of Main Beach and adjacent Englishman Beach, at the fringe of the forest surrounding the Bald Hill grassland, and on thin-soil areas near East Harbor. Elsewhere on San Jose old trees are to be found occasionally in forest openings and on wooded sea cliffs and headlands. It has the habits of a weed-tree, growing rapidly and doing best in the full sun and where uncrowded. Indeed, young plants of the species appeared rather commonly in the new growth that sprang up on disturbed soils along new roads and clearings, and were particularly abundant in these situations about the Camp area. Along the roadside between Headquarters and Main Beach some young *Apeibas* less than two years old had by January 1946 reached a height of 4.5 m. and had developed trunks 13 cm. in diameter.

The large, hairy, tawny or golden leaves and very distinctive fruit combine to make the plant easily recognized. The leaves are velvety, 12–55 cm. long, 6–15 cm. broad, broadest at or above the middle, acute at the apex, and more or less cordate at the base. The twigs and small branched inflorescence are shaggy with coarse tawny or golden hairs. The yellow flowers are 3 cm. broad and are apparently produced continuously from June into January. The peculiar fruit is suggestive of a sea-urchin or a bristly pincushion in form. It is 2–3 cm. high, 6–8 cm. broad in transverse diameter, and densely clothed by great numbers of crowded, spreading, slender, flexible hairy spines. They hang on the tree for some time and become particularly conspicuous while the tree is leafless during the latter half of the dry season. The species is found in Central America and northern South America. (Fl. C. Z. p. 250). *Johnston 8; Erlanson 99, 247, 289; Harlow 64.*

CORCHORUS SILIQUOSUS L.

A small shrubby plant up to a meter tall collected by Erlanson near Main Camp in May 1945. The material collected was evidently from a well-established old plant, having old fruits as well as flowers of the new season. It was probably introduced from the mainland sometime during 1944. The species is widely distributed in tropical America. (Fl. C. Z. p. 251). *Erlanson 196.*

Luehea candida (DC.) Mart.

A large shrub or tree 5–20 m. tall which is one of the characteristic woody plants on thin soil areas of the eastern peninsula. It occurs as far west as

the thin soil area at the south end of the East Loop. Some fine specimens of the tree, readily observed, grow with *Cedrella* and *Spondias* at the margin of East Road at the boundary between Areas 8A and 8B. The plant has a single trunk up to 3 dm. thick, or several strict ones up to 2 dm. in diameter. The trunks are always asymmetric in cross section. The bark of the old trees is tight and finely checkered. The wood is white or brownish and hard. The large leaves are ovate, 15–20 cm. long, 11–16 cm. broad, green above, and pale and somewhat velvety beneath. They have a rounded or obscurely cordate base, a coarsely acuminate apex, and a margin that is coarsely toothed, especially above the middle. The large attractive solitary flowers are 9–10 cm. in diameter and have broad cream-colored petals and numerous conspicuous stamens. They apparently develop in greatest number at the beginning of the rainy season. The fruit apparently takes a year to mature. It is a heavy woody capsule 6–7 cm. long and 3.5–4 cm. broad. Above a narrow rounded base it is very strongly and prominently five-angled and star-shaped in cross section. The leaves of this tree turn yellow and then drop during January and February. During most of the dry season the tree is leafless and decorated only by the woody pods that hang from its otherwise naked branches. The species ranges along the Pacific slope of Mexico and Central America and also in northern Colombia and Venezuela. *Johnston 153; Erlanson 455, 463.*

Luehea Seemannii Tr. & Planch. GUÁCIMO

A large streamside tree found in all parts of the island. It is generally scattered in occurrence but locally becomes rather common along the stream in Area 11B, in the vicinity of Red Hill, in Camp Valley, and in the bottomland forest south of the mangrove swamp in Area 4. The tree is commonly 15–25 m. tall. Old individuals reach giant proportions. A large specimen at the head of Camp Valley approaches 30 m. in height. It has thick buttresses 2 m. in height that span 3.5 m. at the ground level. The trunk is 2.2 m. thick just above the buttressed base. In most individuals of the species the trunk is very irregular in cross section, more or less fluted and distinctly buttressed at the base. The contrasting coloration of the foliage is very distinctive and allows the tree to be easily identified from a distance. The leaves are green and glabrous above and densely hairy and brown on the lower face. They are 10–20 cm. long, 4–11 cm. broad above the middle, obtuse or somewhat truncate at the base, acute at the apex, and toothed on the margin. The inconspicuous cream-colored flowers, 1.5–2 cm. broad, are produced in abundant inflorescences 1–2 dm. long, borne terminal on the leafy twigs. They first appear in December and continue present in diminishing numbers through February. The fruit is a woody capsule 2–2.5 cm. long and about 1 cm. broad which is broadest at the middle and contracted towards both ends. It has a coating of minute brown hairs, has 5 prominent angles, and is more or less star-shaped in cross section. The fruit becomes conspicuous on the tree in March. The old fruits do not fall singly. After all the capsules have freed their seeds, the whole inflorescence is shed with all the old fruits still attached. During April and late March the ground beneath the tree becomes littered with them. The species ranges from Guatemala to Panama. (Fl. C. Z. p. 251). *Johnston 506, 633, 1222, 1380.*

Luehea speciosa Willd.

A few dozen scattered trees of this species rise out of the thicket along the westernmost quarter-mile of Dead End Road. It was observed nowhere else on the island. The trees grow 5–15 m. tall and develop trunks 2–5 dm. thick which are irregular in cross section. The leaves are 12–17 cm. long and are 6–9 cm. broad at or above the middle. They are green above, white or gray with a close tomentum beneath, and have an obtuse or rounded base, an acute apex, and a toothed margin. The white flowers are 4–5 cm. broad and are borne in an open panicle at the end of the branches. The fruit is a hard, woody. ellipsoidal capsule 3–3.5 cm. long and 12–15 mm. thick. It is brownish with short, appressed hairs, and, upon close examination, is found to be obscurely five-sided. The trees were first discovered in mid-January 1946, when bearing maturing fruit and occasional flowers. Flowering had ceased by the first of February. When last seen at the end of that month the trees were still holding their leaves. Widely distributed in tropical America. (Fl. C. Z. p. 252). *Johnston 1283.*

Triumfetta panamensis, sp. nov.

Frutex 1–2 mm. altus laxe ramosus; ramis teretibus saepe 2–3 mm. crassis hirsutis vetuste glabratis; foliis viridibus acutis, margine serratis, supra pilis simplicibus sparse hirsutis, subtus pilis paucis simplicibus et stellatis donatis; foliis majoribus 5-costatis ovatis vel cordatis simplicibus vel obsolete trilobatis 7–14 cm. longis 5–11 cm. latis 2–7 cm. longe petiolatis, minoribus saepe 3-costatis lanceolatis simplicibus 3–10 cm. longis 1–5 cm. latis 5–15 mm. longo petiolatis; cymis umbellatis 2–5 mm. longe pedunculatis 3–8-floris axillaribus vel oppositifoliatis, bracteis subulatis 3–4 mm. longis ciliatis; alabastro floris subcylindrico 3.5 mm. crasso evidenter pallido-hirsuto; sepalis 5 sublinearibus 8–10 mm. longis apicem versus ca. 1.8 mm. longe appendiculatis; petalis oblanceolatis ca. 8 mm. longis, supra medium ca. 2.2 mm. latis, apice obscure sparseque eroso-dentatis, imam ad basim margine ciliatis, in facie superiore 1.5–2 mm. supra basim villosis alibi glabris; androgynophoro ca. 0.6 mm. alto glandulis 5 suborbicularibus ca. 0.5 mm. diametro ca. 0.1 mm. distantibus ornato; annulo cupuliformi 0.5–0.7 mm. alto, margine sparse undulato-dentato ciliatis; staminibus ca. 30 biseriatis, filamentis 4 mm. longis; ovario subgloboso; fructu 3–4-loculato globoso ad 1 cm. diametro aculeis incluso; aculeis numerosis congestis 2–3 mm. longis rigidis sub lente evidenter pilosis apice simpliciter uncinatis.

TYPE: *Johnston 1112*, San Jose Island, Navy Cove Road, roadside at edge of forest.

A loosely and much branched shrubby plant 1–2 m. tall, growing with *Trema* in second growth at the edge of the forest along the midsection of the Navy Cove Road. Only one colony was seen. The leaves have appressed hairs on the upper surface and have serrate margins. The larger ones, 7–14 cm. long and 5–11 cm. broad, are ovate and frequently somewhat three-lobed. They are usually 5-ribbed and have petioles 2–7 cm. long. The leaves on the flowering twigs, however, are lanceolate, 3–10 cm. long and 1–5 cm. broad, generally 3-ribbed, and have petioles 5–15 mm. long. The small orange flowers are borne in small loose clusters in the leaf axils along the somewhat bristly twigs. The cylindrical, grayish-villous flower-buds are 8 mm. long, 2.5 mm. thick, and terminated by free sepal tips 1.5 mm. long. The orange petals are about 8 mm. long. The fruit is distinctive. It is a

globose bur about 1 cm. in diameter consisting of a central body armed with innumerable stiff, slender, spreading, apically-hooked spines.

The species is known only from Panama, where it has been repeatedly collected, especially in the Canal Zone (*Hayes 155; Standley 25, 613, 26789, 28511, 29204; Pittier 6925; White 52*). It has passed as representing *T. hispida* Rich. but is not very closely related to that species. Its closest relative seems to be *T. Josephina* Polak, of Costa Rica, but it differs in its much less hairy leaves, very shaggy flower buds, and in the much more numerous, very crowded, longer, hairy spines of its fruit. From the widely distributed *T. subtrilobata* Jacq. it differs in the much larger, shaggy flower buds, the more numerous stamens, and the hairy fruit. (Fl. C. Z. p. 251, sub *T. hispida*). *Johnston 1112.*

MALVACEAE

Abutilon crispum (L.) Don

An herbaceous plant confined to areas of thin soil on the eastern peninsula. It has lax, trailing stems and forms growths 4–12 dm. broad. Less than a dozen plants were seen, these scattered in open deciduous forests in Area 8A and near East Harbor. The species is widely distributed in tropical America. (Fl. C. Z. p. 253, sub *Gayoides crispum*). *Johnston 673.*

Abutilon Theophrasti Medic.

A few flowering and fruiting plants of this herb were found about the Goat Barn in January 1946. It was obviously introduced on San Jose Island in unclean hay shipped out of New Orleans. The species is a native of the Old World but is widely established as a weed in southern United States. *Johnston 1353.*

Hibiscus esculentus L. Okra

Numerous young plants of Okra were found growing at the roadside north of the Motor Pool in January 1946, and were beginning to flower and fruit a month later. The plant was seen growing, apparently cultivated, in the garden at the Navy Station in March 1945. It persisted after the station was abandoned and was still growing vigorously and flowering and fruiting abundantly in February 1946. The species is a native of the Old World and is frequently cultivated in the American tropics. It can, however, go wild and at times appears as a weed on cleared ground. (Fl. C. Z. p. 257). *Johnston 1090.*

Hibiscus tiliaceus L. Mahoe

A shrub or tree, 2–6 m. tall, common at the head of sandy beaches and usually abundant in the thickets on slopes within a half-mile of the coast. It is readily recognized by its broadly rounded cordate leaves, 8–15 cm. long and 9–17 cm. broad, which are green above and pale beneath. The old leaves turn yellow before falling. The showy flowers, 7–9 cm. long, are bright yellow when new but change to reddish with age.

This widely distributed tree of tropical coasts is represented in America by two endemic varieties. Our plant belongs to the variety *abutiloides* (Willd.) Hochr., ranging from Mexico and Florida south to Ecuador and the Guianas, which is distinguished by its large, very coarsely lobed floral involucre and large calyx with a non-exserted tube. The other representative

of the species in America, **H. tiliaceus** var. **pernambucensis** (Bertol.), comb. nov., (*H. pernambucensis* Bertol., 1820), ranges along the Brazilian coast south of the Amazon. It has the smaller calyx, exserted calyx-tube, and shallowly toothed involucre of the Old World plant, but is unique in its campanulate rather than cup- or saucer-shaped involucre tube. True *H. tiliaceus*, described from plants of peninsular India, occurs in Africa, India, and Malaysia, and has recognizable varieties in China, Formosa, Indo China and perhaps also in Polynesia. (Fl. C. Z. p. 256). *Johnston 246; Erlanson 11.*

Malva neglecta Wallr.

A single fruiting plant of this species was found at the Goat Barn in January 1946. It is a European weed widely established in the United States and was evidently introduced onto the island in unclean hay shipped out of New Orleans. *Johnston 1154.*

Malachra alceifolia Jacq.

A coarse annual herb, becoming 1–1.5 m. tall, which was locally abundant in disturbed soil at the roadside just back of Englishman Beach in January 1946. It has clusters of orange-yellow flowers subtended by coarse, cordate, green or white-blotched bracts. The plant appeared near the site of an early settlement on the island and may have sprung up from dormant seeds disinterred in road making. In any case it is probably not a recent introduction from the mainland. The plant is widely distributed in tropical America. (Fl. C. Z. p. 255). *Johnston 873.*

Pavonia malacophylla (Nees & Mart.) Garcke

Frequent in disturbed soils along roads and in clearings in the northern and eastern parts of the northern half of the island. Only a relatively few widely scattered plants were noted in the dry season of 1945. By the following season, however, it had become more generally distributed and was even abundant in places. Originally the species was probably confined to the eastern peninsula. It is a coarse herb with erect stems 1–2 m. tall, and is clothed throughout with a velvety covering of abundant short, soft, more or less oily hairs that make it very clammy and unpleasant to handle. The pure white flowers, 2.5–3 cm. long, are produced abundantly along the upper half of the leafy stems. They first appear in December, become abundant and conspicuous in January, and usually disappear by the end of February. The involucre surrounding the calyx suggests that of a species of *Senecio*, and is composed of 20–24 linear, parallel, juxtaposed, hairy, viscid bracts 12–14 mm. long and 0.6–1 mm. broad. The numerous small fruits are black and are exposed when the calyx and involucre become radiately spreading at maturity. They have a glutinous surface which adheres to clothing. They are probably distributed by man and animals.

The species ranges from Mexico and Cuba south to Bolivia and Brazil. The San Jose plants differ from those of the mainland in having white, rather than pink or red flowers, and in having 20–24, rather than 15–20 involucral bracts, but otherwise seem very similar. *Johnston 552, 840; Erlanson 56.*

Pseudoabutilon spicatum (HBK.) R. E. Fries

Seen only once on the island, on thin soil in an opening in a bit of deciduous forest northwest of the Air Strip. It is an erect, simple or sparingly branched

annual herb about a meter tall. The leaves are cordate, 5–16 cm. long and 5–15 cm. broad. The small orange flowers are borne in an interrupted subspicate panicle projecting well above the herbage. The species is widely distributed in tropical America. (Fl. C. Z. p. 253). *Johnston 1141.*

SIDA ACUTA Burmann

A weed well established in the clearing about the Navy Station as early as November 1944. In January 1946 it was still common there and had also appeared as a weed in the lawns at Camp. The plant is evidently a recent immigrant from the Isthmus. It is a loosely branched herb with hairy stems, toothed leaves, and small yellow flowers. The species is very widely distributed in the tropics. I am indebted to Mr. Ian D. Clement for the identification of this and the other Sidas collected on San Jose. (Fl. C. Z. p. 254). *Johnston 897, 1083; Erlanson 127, 347.*

Sida linifolia Cav.

A slender-stemmed annual herb occasional in areas of thin soil on the eastern peninsula and on islets, rocks and cliffs along the coast, but somewhat more common in the grassland at Bald Hill. The species may be spreading in second growth. In 1946 a few plants were noted here and there along roads and trails through thicket and open forest on the northern part of the island. The plant is at first simple and erect and 3–4 dm. tall, but at the close of the rainy season it may attain more than a meter in height and become loosely much branched. The linear or lance-linear leaves, 5–14 cm. long and 2–10 mm. broad, are rounded at the base and have a petiole 5 mm. long or less. They have entire margins. The small white or yellow flowers are borne in umbellate clusters at the end of the branches. The species is widely distributed in tropical America. (Fl. C. Z. p. 254). *Johnston 927, 946A, 1162, 1182, 1213; Erlanson 288.*

Sida rhombifolia L.

Observed at only two places on the island, near the main road just east of Camp, and near the lookout at East Harbor. At both places it was locally abundant in second growth that margined areas of thin soil, associating with no introduced plants, and giving every evidence of being native on the island. It is slender-stemmed, erect, and 1–2.5 m. tall, and becomes much branched. The oblong-elliptic leaves, 2–5 cm. long and 1–2.5 cm. wide, are broadest at or above the middle, pale and thinly tomentose beneath, toothed on the margins, and borne on petioles 1–5 mm. long. The small corollas are orange. The species is very widely distributed in the tropics. (Fl. C. Z. p. 254). *Johnston 811, 836.*

Sida setifera Presl

Growing abundantly in disturbed places margining thin soil areas at Max Point and near East Harbor, and occasional in second growth along roads and trails through low thickets here and there on the northern part of the island. The plant grows 5–15 dm. tall, becomes much branched and bushy, and in late December bears its orange flowers in profusion. The cordate leaves, 3–8 cm. long and 2–6 cm. broad, are grayish green, soft velvety, and toothed on the margin. The slender petiole is somewhat bristly and 2–5 cm. long. The flowers are borne in crowded clusters towards the ends of the

leafy branches. The corolla, 10–15 mm. broad, is orange with a maroon center. Away from San Jose Island this species is known only from western Mexico and adjacent Central America. *Johnston 979, 1282.*

Sida spinosa L.

Occasional in the grassland at Bald Hill. It is an erect, very slender and sparingly branched herb 5–10 dm. tall. The leaves, 2–5 cm. long and 5–18 mm. wide, are broadest at the base, evidently crenate-toothed, pale on the lower surface, and borne on a slender petiole 3–11 mm. long. The small crowded flowers have orange corollas. The species is widely distributed in tropical America. (Fl. C. Z. p. 254). *Johnston 1061A.*

Sida urens L.

Growing abundantly, locally, along the road just back of Englishman Beach, its slender, elongate stems scrambling in low second growth. The green stems and leaves are bristly. The cordate leaves, 5–9 cm. long and 18–40 mm. broad, have an attenuate apex, toothed margins, and a petiole 1–3 cm. long. The crowded flowers have bristly buds and orange corollas about 1 cm. broad. The species is widely distributed in tropical America. (Fl. C. Z. p. 253). *Johnston 874.*

BOMBACACEAE

Bombax quinatum Jacq. CEDRO ESPINOSO, POCHOTE

A readily recognized tree that is widely distributed on San Jose Island. It grows on headlands, cliffs and islets along the coast, about rock outcrops on slopes and crests of exposed ridges, and on level areas with thin soil both near the coast and in the interior parts of the island. In very exposed places, especially on cliffs and islets along the coast, it may form a small gnarled tree only 2–5 m. tall, but in the interior of the island and frequently also on headlands it commonly forms a large, even giant tree 10–30 m. tall, and has a ponderous trunk, heavy, widely spreading branches, and a broad rounded crown. Wherever it grows and whatever its form it is readily recognizable because of the large, hard, sharp-pointed, broadly conic spines 15–30 mm. high, borne in abundance on its trunk and branches. Although one of the most characteristic trees of the Deciduous Forest and best developed on the thin soil areas of the eastern peninsula and on the scanty soils on headlands, it is not entirely absent in the evergreen forests and dense thicket. Occasionally in these latter plant-associations a large tree of the species is to be found, but these, like the giant individual looming above the forest in Camp Valley, are always rooted on well-drained rock outcrops that become very dry during the rainless season.

The heavy, spiny trunk is generally broadly furrowed, commonly asymmetric in cross section, and usually coarsely buttressed at the base. At breast height it may reach as much as 2 m. in thickness. It is surrounded usually by large roots spreading for the most part unburied over the thin soil on the rock on which it grows. When cut the bark is revealed to be thick, juicy, and pinkish purple in color. The heavy spreading branches usually support a vigorous growth of the epiphytic cactus *Cereus costaricensis*, and its twigs are practically always festooned with a gray lichen, a species of *Ramalina*, that becomes very conspicuous when the tree is leafless. Generally the tree supports few, if any, vines.

The leaves are palmately compound and usually composed of five leaflets. They are glabrous, broadly oblanceolate or narrowly obovate, broadest at or above the middle, acute and somewhat acuminate at the summit, acute at the base, and shortly but distinctly petiolate. The largest leaflet becomes 10–15 cm. long, 5–6.5 cm. broad, and has a petiole about 5 mm. long. The foliage begins to be shed in November or even late October. By mid-December most trees are leafless. They continue in this state through the dry season. The species is the first of the deciduous trees to shed its foliage and the one which spends the longest period, about six months, in a leafless condition.

The principal period of flowering is in January and February. The flowers, though produced in great numbers on the leafless twigs, do not make a particularly conspicuous display. The corolla lobes are elongate, 9–10 cm. long and 8–10 mm. broad above the middle, and are brownish on the outer surface and pure white on the inner. When the flower is open they are ascending or somewhat outcurving. The conspicuous part of the flower is the brushlike cluster of pure white stamens. Old flowers turn brown. During the height of the flowering period the ground beneath the tree is littered with dried, now brown, flowers fallen from the branches above.

The fruit is a somewhat 5-sided dry pod, 6–9 cm. long and 2.7–4 cm. broad, which is contracted at the base and has a broad truncate or retuse summit. It is smooth and lustrous brown outside and at maturity splits into 5 woody recurving sections and frees a mass of brownish fibers in which seeds are embedded. After dehiscence it may hang on the tree, star-like, for some time before falling.

The species ranges along the Pacific slope from Nicaragua to Panama and at low altitudes in northern Colombia and Venezuela. Until recently the plant has been known as *Pachira, Bombax*, or *Bombacopsis Fendleri*, but, as pointed out by Dugand, Contr. Hist. Nat. Colombia **1: 2** (1938), these are late synonyms of *Bombax quinatum* Jacq. (1760). In a later paper, Caldasia **2:** 61 (1943), Dugand attempted to identify the plant with *Bombax Ceiba* L. (1753). With this, however, I cannot agree. *Bombax Ceiba* L., Sp. Pl. 511 (1753), was not described from specimens but based upon a variety of descriptions and illustrations found in earlier books. These latter obviously refer to the trees subsequently called *Ceiba pentandra* and *Gossampinus heptaphylla*, the larger number to the *Ceiba*. If the name *Bombax Ceiba* is not to be discarded as a nomen confusum, it must be identified with one or the other of the two elements contained in the original concept. In the second edition of his Species Plantarum, Linnaeus added a third element to his already thoroughly muddled concept of *B. Ceiba*. *Bombax quinatum* Jacq. was given as a new synonym. Dugand would use this multiplication of errors as a basis for applying the Linnaean binomial to our present plant. By excluding all the original elements in the species, the name *B. Ceiba* would be left applicable to our plant and it would become the type species of the genus *Bombax*. When Linnaeus set up the genus *Bombax* in the original edition of the Species Plantarum, three species were in the genus, *B. Ceiba*, *B. pentandrum*, and *B. religiosa*. The second of these is *Ceiba pentandra*. The third mentioned is a mixture of *Gossypium* and *Cochliospermum*. With *B. Ceiba* referred to either *Ceiba* or *Gossampinus* none of the species in the original concept of *Bombax* would represent that genus as it has been tradi-

tionally accepted. The genus needs to be retypified by action of the next Botanical Congress. It has been suggested that *B. malabricum* be designated as genotype, but since that species is a member of *Gossampinus*, it would necessitate the renaming of all the American species traditionally classified under *Bombax*. I believe that Dugand's suggestion that the present species be made the genotype of *Bombax* should be followed. For it, however, it is much better to use Jacquin's specific name than the one Linnaeus applied to his hopelessly confused and very ambiguous concept. (Fl. C. Z. p. 260, sub *Bombacopsis Fendleri*). *Johnston 215, 569, 1054, 1180; Erlanson 302.*

Bombax sessile (Benth.) Bakh. CEIBO

A tree of distinctive appearance frequent in forests and along their borders, particularly over the southern two-thirds of the island. On wooded slopes and cliffs near the ocean it may be a small tree only 3–5 m. tall, but inland it grows commonly 10–25 m. tall. It generally overtops surrounding vegetation. The trunk, stiff, straight, and symmetrical as a telephone pole, 2–4 dm. and rarely 5 dm. thick, is propped at the base by stiff triangular plank-buttresses 5–12 dm. high. The bark is pale and peels off in more or less rectangular flakes, papery or corky in texture. The crown is composed of relatively few short, horizontal branches. It is not dense and is disproportionately small and narrow for the size of the tree.

The light green leaves are palmately compound. The 6–9 leaflets are oblanceolate, rounded or emarginate at the apex, broadest well above the middle, and gradually narrowed towards the acute, sessile base. They are rather firm and thickish in texture. The largest leaflets are 7–15 cm. long and 2–5 cm. broad. The foliage is shed and renewed sometime during the dry season, the timing of these operations varying greatly from tree to tree. With most species found on the island, the individual trees go through these operations together, as if by pre-arrangement, completing one or both within a particular period of a few weeks. This *Bombax*, however, does not show this regimented behavior. Some trees may shed all or part of their foliage as early as the first of December, while other individuals may do it in varying degrees during any time up to late in the dry season. Some remain leafless for a long period, others for a short time. Leaf renewal may proceed rapidly or be variously prolonged and perhaps not completed until late in the dry season.

The tree flowers between mid-December and mid-February, when leafless or bearing few to many leaves. The brown flower buds are slender, elongate, and 15 cm. in length. The petals are elongate, 10–12 cm. long, brownish outside and greenish on the inner face, and upon the opening of the flower they become reflexed and contorted. The conspicuous part of the flower is the white, brush-like cluster of stamens which surmounts a very elongate staminal tube.

The fruit is matured between late February and mid-April. It is a thick-walled, smooth ellipsoidal pod, 10–15 cm. long and 4–5 cm. in diameter at the middle, which becomes yellowish and falls apart at maturity, freeing masses of brownish wool and embedded seeds. The thick shell of the pod falls away in five elongate sections. The central axis of the fruit, usually 7–10 cm. long, surrounded with a gradually diminishing puffed-out mass of wool, remains attached to the tree for several more weeks. The wool, a kind of kapok, may accumulate in quantities below a large tree, becoming even ankle deep.

During the height of the fruiting season masses of it, stirred up by every passing auto, become a common roadside feature. The species is known only from Panama and adjoining Costa Rica. It was first discovered on Taboga Island. (Fl. C. Z. p. 260, sub *Bombacopsis sessilis*). *Johnston 414, 493, 560, 607, 943; Erlanson 119.*

Ochroma lagopus Sw. BALSA

When the Army began operations on San Jose early in 1944, Balsas were rare on the island. Less than a dozen mature trees over 20 m. tall dominated a relatively open, apparently second-growth forest, just southwest of English-man Beach, and several trees over 10 m. tall grew on the cliff at the north end of the cove formed at the mouth of the canyon draining Area 11B. Though these trees had been fruiting for years, no seedlings or young trees of the species occurred anywhere in their vicinity. Balsa seedlings, however, appeared promptly along roads and on clearings made by the Army bulldozers, and by the end of the rainy season of 1944 they had become a conspicuous feature along many roadsides, especially those in areas of Thicket and North Forest. They were especially abundant and vigorous along the road east of Red Hill, where, in favorable places, many individuals attained nearly 3 m. in height by November, after approximately six months of growth.

The dramatic appearance of incredible numbers of young Balsas on San Jose is not unprecedented. Elsewhere in the American tropics Balsa seedlings frequently appear in great abundance on newly cleared land, and, as on San Jose, surprisingly even in localities distant from existing mature seed-producing trees of the species. Seeds of this tree can remain dormant for long periods and are believed to be widely distributed in tropical soils. They need only to be exhumed and exposed to the sun to germinate promptly. The Balsa plays the role of an opportunist. It appears suddenly in disturbed places, grows rapidly, scatters numerous crops of seeds, and then, reaching an early old age, disappears, as the slower growing, longer lived permanent vegetation crowds in and again dominates the formerly disturbed place on which the Balsa had luxuriated for a time. In the past, as local conditions gave it opportunity, the tree has doubtless been present, here and there, from time to time, in all parts of the island. Thus it could have scattered the seeds that were to be at length unearthed and to germinate in such spectacular numbers in the wake of the bulldozers. This is the only tenable explanation for the incredible numbers of young Balsas that have appeared so suddenly on the island. The eastern peninsula, where young Balsas are so numerous, is, for example, several miles from the only mature seed-producing trees on the island, is separated from them by a height of land, and is not favored by any wind that could possibly transport their seeds. Here, as elsewhere on the island, the seedlings must have sprung from unearthed, dormant seeds produced long ago by trees formerly growing in the general vicinity. Such trees could have sprung up where the fall of large trees, a landslide, or heavy erosion following a severe storm may have made a temporary break in the dominant vegetation. Many of them may have developed in a period when the island had settlements, and the abandoned clearings of migratory agriculture may have provided favorable sites for the growth of the tree.

The tree is famous not only for its very lightweight wood but also for its rapidity of growth. Given optimum conditions it can become 15–20 m. tall

and develop a trunk 5–7.5 dm. thick in only five or six years of growth. The most rapidly growing seedlings on San Jose had reached slightly over 10 m. in height, had developed trunks 1–1.7 dm. thick, had several branches, had produced some flowers, and were maturing their first fruit in February 1946. These exceptionally vigorous trees had grown for twenty months and had benefited from two rainy seasons. They were, however, exceptions, for most seedlings grew at little more than half this rate. The maximum size which Balsa can be expected to attain on San Jose probably can be judged from the large, broad, spreading old individuals near Englishman Beach. These are over 20 m. tall and have trunks about 1 m. thick at 3 m. above the ground.

The foliage of young and old trees differs much in appearance. The leaves on old trees are about 3 dm. long and nearly as broad, green and glabrous above, gray or brown with a fine close tomentum beneath, cordate at the base, and obscurely and broadly three-lobed. They are dropped shortly after the tree begins to flower in January. Old trees are leafless during the dry season. Vigorous young trees, however, are practically evergreen, shedding only a small fraction of their foliage during the dry months. Their leaves are dull green, minutely hairy on both faces, 3–10 dm. broad, broadly and conspicuously lobed, and noticeably angular in outline. They flower and fruit while still retaining most of their herbage.

The flower, 12–15 cm. long, is very coarse and long-stalked. It has a thick, fleshy, cylindrical calyx and elongate petals which are nearly white when fresh but become brown in age. As the young fruit begins to grow, the calyx and corolla are shed. They can accumulate in numbers beneath large trees and become conspicuous objects on the forest floor. The fruit is an elongate, angulate, prominently ribbed pod, 11–16 cm. long and 2–2.5 cm. thick, which opens at maturity to free conspicuous amounts of brownish wool and embedded seeds. The species is widely distributed in tropical America. (Fl. C. Z. p. 260, sub *O. limonensis*). *Johnston 470, 511.*

STERCULIACEAE

Guazuma ulmifolia Lam. GUÁCIMO

A tree 5–10 m. tall, frequent in open forests and especially those on and about areas of thin soil. It occurs in greatest abundance in the apparently old second-growth forest near the giant Balsas back of Englishman Beach. Elsewhere on the island it is most frequently encountered on the eastern peninsula. The leaves, 10–15 cm. long and 6–7 cm. broad, have a very oblique, asymmetric base, an acuminate apex, and a toothed margin. They are green above and pallid or tan beneath. Most trees shed their foliage in February and remain leafless for the remainder of the dry season. Foliage is renewed and flowers appear in late April. The small cream-colored flowers are borne in small loose cymes along leafy twigs. The woody fruit, containing a sweetish edible pulp and hard seeds, is black, subglobose, 18–23 mm. in diameter, and has its surface studded with crowded hard protuberances. The fruits are produced in large numbers and become conspicuous on the tree after the leaves are shed. The species is widely distributed in the American tropics. (Fl. C. Z. p. 263, plate 52). *Johnston 353; Erlanson 76, 277.*

MELOCHIA CORCHORIFOLIA L.

A weed established at the Goat Barn. It was first collected by Erlanson in May 1945, and was still persisting at the Goat Barn in February 1946. It is an Old World species well established in southern United States, whence it was introduced on San Jose in unclean hay. *Johnston 1243; Erlanson 189.*

MELOCHIA MELISSAEFOLIA Benth.

A weed well established in the lawns at Main Camp in January 1946. It was probably introduced on the island in the turf brought from the Canal Zone. The species ranges from Costa Rica and Panama into northern South America and is usually found in low ground. (Fl. C. Z. p. 264). *Johnston 898.*

STERCULIA APETALA (Jacq.) Karst. PANAMA TREE

A fruit of this species, containing numerous dead, immature seeds, was found washed up on the beach in Bodega Bay. It is a common tree in the Canal Zone and ranges from Mexico and the West Indies south into northern South America. (Fl. C. Z. p. 261, plate 50).

Waltheria americana L.

A coarse herb or somewhat shrubby plant with numerous elongate, ascending stems. It is usually bushy in growth and generally 1–2 m. tall. The younger stems and the foliage are grayish and soft velvety. The leaves are 6–12 cm. long, 3–7 cm. broad above the base, usually obtuse at the apex, and either rounded, truncate, or somewhat cordate at the base. The tiny orange flowers are borne in small tight clusters produced abundantly on the leafy twigs.

Before the Army arrived on San Jose in early 1944, this plant was probably confined to areas of thin soil and to open places on sea cliffs and was not at all common. In remote, entirely undisturbed parts of the island it still persists as an unobtrusive, infrequent plant in such habitats. The wake of the Army's bulldozer, however, provided a new habitat, and having taken advantage of this with great rapidity, the plant is now one of the commonest of roadside species. In October 1944, a small colony of young flowering plants had appeared on a fill at Main Camp. By the following March flowering and fruiting plants were present along many roads. Less than a year later plants were to be found along roads in all parts of the island and were abundant and conspicuous in many places. It is now a very common plant along all roads through thicket and open forest, and an important element in second-growth vegetation. The species, a variable one, is widely distributed in the tropics. (Fl. C. Z. p. 263). *Johnston 88; Erlanson 40, 477; Harlow 83.*

DILLENIACEAE

Curatella americana L. SANDPAPER TREE

A large shrub or small tree, 2.5–5.5 m. tall, notable for its gnarled trunk, rigid, crooked branches, and stiff, coarse, extremely harsh foliage. Scattered individuals of this tree grow in the western portion of the grassland on Bald Hill and in the thickety growth margining the grassy openings on thin soil back of the sea cliffs at East Harbor. Two trees were noted on a sea cliff near South Beach.

The leaves are 1–2 dm. long and 7–11 cm. broad and have surfaces as harsh and scabrid as sandpaper. Their lower surface has conspicuous paralleling

veins and a prominent fine reticulum of veinlets. The white flowers, 1 cm. broad, appear in January and are borne in large numbers in loose clusters along the twigs. The species is widely distributed in tropical America, where it is one of the characteristic trees on savannas. (Fl. C. Z. p. 265). *Johnston 575.*

Davilla lucida Presl CHUMICO

A common woody vine, growing over thickets and climbing high in forests in all parts of the island. Its leaves are distinctive. They are stiff, very scabrous, elliptic or obovate-elliptic in outline, 7–14 cm. long, 3.4–8 cm. broad, rich green and somewhat lustrous above, paler beneath, and entire or nearly so on the margin. Like other members of this family the veins on the lower leaf surfaces are very prominent and parallel.

The large stems of this species, frequently 5–7 cm. and rarely up to 12 cm. thick, constitute one of a class of very distinctive vine-stems frequently encountered in the forests. These stems, all produced by members of the *Dilleniaceae* and belonging to the genera *Davilla, Dolicarpus,* and *Tetracera,* are characterized by a flaky bark, brown or glaucescent and pinkish brown in color, which scales off in papery flakes 1–2 cm. broad. Usually in a limited area of forest floor and generally near or even about a large tree, they form large, loose, irregular coils, loops, and undulations before soaring aloft to the canopy above. Though they may be associated with the stems of numerous other vines, their coloration and distinctive bark give them individuality wherever they may occur. Though very similar, the stems of the several Dilleniaceous vines can be distinguished by slight differences in color. When weathered flakes are scraped from the bark of *Davilla lucida,* the freshly exposed bark is pinkish brown and slightly but perceptibly chalky. The cut stem shows numerous rays in cross section.

The bright yellow flowers, about 15 mm. broad, are borne in terminal panicles 1–1.5 dm. long. They begin to appear towards the end of the rainy season and become abundant in January and February, when the small but brightly colored fallen petals may become sufficiently numerous on the forest floor to attract attention. The fruit, a globose structure about 7 mm. in diameter, is commonly orange in color and minutely hairy. It becomes abundant and conspicuous in March and April. The species ranges from Mexico to northern Colombia. (Fl. C. Z. p. 264, sub *D. Kunthii*). *Johnston 247, 390, 423, 625, 815, 1175; Erlanson 12.*

Davilla Sagraeana Rich.

A woody vine seen only on thickets and forest margins along the Loop Road about 100 yards northwest of Met Road. It grew with *D. lucida,* and like its congener was in full fruit in April 1945. The plants differed from those of *D. lucida* in having slightly smaller and paler glabrous fruits, more slender stems, and thinner, paler green, less hairy and nearly smooth leaves. Most of the plants were typical of the present species, but some had scabrous foliage and are possibly hybrids.

The species ranges from Cuba and Mexico south to northern Colombia and Venezuela. It has been confused with *D. rugosa* Poir., a very hairy plant native to eastern Brazil and the Guianas. (Fl. C. Z. p. 264, sub *D. rugosa*). *Johnston 814, 814A.*

Doliocarpus dentatus (Aubl.) Standl.

A high-climbing woody vine abundant in forests, particularly those on the southern half of the island. Its large stems, 3–12 cm. thick, are frequently seen inside of forests. The bark is usually grayish outside but scales off in papery flakes to reveal a cinnamon-brown inner bark. The stems in cross section are distinctive. Those over 2 cm. thick have conspicuous rays and also one or more very conspicuous concentric rings of included phloem.

The leathery leaves, 8–18 cm. long and 3–7.5 cm. broad, are broadest above the middle and gradually taper towards the acute base. They are nearly glabrous, smooth, green above, pale beneath, and usually toothed above the middle. The white flowers, about 8 mm. broad, have pedicels 10–16 mm. long and are borne in umbellate clusters of 10–50 along the leafy stems. They are produced abundantly in late February and March. The fruit is somewhat fleshy, pinkish red, globose, berry-like structure 6–7 mm. in diameter. It is matured in great abundance and becomes very conspicuous and decorative on the trees during March and April. During March 1945 there was a very attractive and bountiful display of the fruit along South Road. The species ranges in Central America, the West Indies, and northern South America. (Fl. C. Z. p. 265). *Johnston 520, 564, 582; Erlanson 44, 79; Campbell 7.*

Tetracera fagifolia Willd. ex Schlect.

A high-climbing woody vine frequent on thickets and forests. The main stems, usually 3–5 cm. but rarely up to 13 cm. thick, have a flaky bark which is coca-colored when its weathered outer surface is scaled off. The wood in cross section shows many pronounced rays. The grayish green leaves are broadest at or below the middle, ovate to lanceolate in outline, 5–15 cm. long, 3–6 cm. broad, and somewhat scabrous on both surfaces. The margins are entire or only very obscurely and finely toothed towards the apex. No flowering plants were seen. The fruit consists of 1–4 lustrous brown diverging beaked follicles nearly 1 cm. long.

The species ranges from Guatemala and Cuba south to northern South America. It has been previously identified as *T. oblongata* DC., but that species, one with coarsely toothed leaves, is confined to southeastern Brazil. Our plant seems to agree closely with the type of *T. fagifolia* from the Pernambuco region, and with collections by Spruce from the Rio Negro. Authors have identified *T. fagifolia* with *T. rotundifolia* Smith, but that seems incorrect, since Smith's species seems to represent the very different *T. surinamensis* Miq. (Fl. C. Z. p. 265, sub *T. oblongata*). *Johnston 309, 624, 724, 1140.*

Tetracera volubilis L.

A woody vine abundant on the island and widely distributed in both forest and thickets. The large main stems, 4–12 cm. thick, are frequently encountered in the forests. The cut stems show numerous rays. The stiff leaves are usually broadest above the middle, coarsely and irregularly toothed, and are very scabrous. They are 6–18 cm. long and 4–9 cm. broad. The white flowers, about 1 cm. broad, are produced in branched clusters. They appear towards the close of the rainy season and are frequent as late as January. The fruit consists of groups of four lustrous brown, beaked, diverging follicles borne in large numbers in heavy, usually pendent terminal panicles 15–

20 cm. long. The species ranges from Mexico and Cuba south to northern Colombia. (Fl. C. Z. p. 265). *Johnston 321, 355, 391, 522, 669, 1268; Harlow 42, 67, 100.*

OCHNACEAE

Ouratea guatemalensis Engler

A slender shrub or small tree, 1.5–6 m. tall, which is common inside of shaded forests on all parts of the island. Its stiff, lustrous leaves are lanceolate to oblanceolate, 1–2 dm. long, 2.5–5 cm. broad, and finely but sharply serrate on the margin, particularly above the middle. The finely but very sharply saw-toothed margin of the foliage allows the plant to be quickly distinguished from the other understory trees and shrubs with which it grows. Also characteristic of this plant is its very attractive crimson new foliage. The bright yellow flowers, 15–18 mm. broad, are borne in loose racemes 5–10 cm. long. They are most abundant in January and February. The fruit is unusual, consisting of 1–5 firm, ellipsoidal, olive-green or bluish green carpels 6–8 mm. long borne on top of a broadly obovoid, fleshy, bright red torus 6–8 mm. in diameter. The species ranges from Mexico to Panama. (Fl. C. Z. p. 266, sub *O. Wrightii*). *Johnston 351, 460, 579; Erlanson 9; Andersson.*

Sauvagesia pulchella Planch.

A small, slender herb, 1–2 dm. tall, growing on thin soil at the summit of sea cliffs at East Harbor and near South Beach. The small flowers are white. The species is known only from Panama and tropical South America, chiefly on savannas. (Fl. C. Z. p. 266). *Johnston 190; Erlanson 568; Harlow 79.*

Sauvagesia tenella Lam.

Growing in the grassland at Bald Hill and in the grassy areas back of the sea cliffs at East Harbor. A small, delicate herb with white flowers. A species widely distributed in tropical America, usually on savannas. (Fl. C. Z. p. 266). *Johnston 326; Erlanson 587.*

MARCGRAVIACEAE

Souroubea venosa Schery

An epiphytic shrub with many clambering stems that forms dense growths in trees along streams and on wooded coastal cliffs. It was seen in all parts of the island and is apparently rather common in its particular habitats. Growing high in the tree, however, it seldom attracts attention. A good growth of it, readily observed, may be seen in trees growing on the bluffs at the east end of Observer Beach. Main stems, growing down to the ground along the trunk of the host, may become 10 cm. thick. The principal stems and branches in the trees are usually only 2–4 cm. thick. When cut they show a large central pith. The obovate leaves, 7–15 cm. long and 4–9 cm. broad, are broadest above the middle, obtuse or rounded at the apex, and gradually narrowed towards the base. They are shed during February and renewed in late March before the plant flowers. The small flowers are each associated with a tubular nectary 7–8 mm. long. They are borne in racemes up to 15 cm. long, which are produced on the plant in great abundance during April and early May. The species is known only from Panama. *Johnston 692, 1093; Erlanson 80.*

THEACEAE

(Identifications by C. E. Kobuski)

Pelliciera rhizophorae Planch. & Tr.

This remarkable tree grows in limited numbers in the mangrove swamps at Main Beach and at Playa Grande. It develops best along the main drainage channels of the swamp in constantly wet soils that are very shallowly inundated at high tide, usually in company with *Rhizophora* and *Laguncularia*. Although present in the mangrove swamp at Playa Grande it was not found in the near-by very extensive estuarine swamp forest at the mouth of the Rio Marino in which *Laguncularia* and *Avicennia* dominate. The largest colony of the tree on the island, and the one very convenient for study, is that near the stream-mouth and just back of the east end of Main Beach.

The tree grows 6–15 m. tall, has a well-developed, simple, erect trunk and a narrow, elongate crown. Its lowest branches are usually only 15–20 dm. above the ground. The twigs tend to be arcuately curving. The base of the tree is unique. The lower 3–10 dm. of the trunk is conic and fluted and as much as 9 dm. in diameter at soil level. Above the solid conic base the trunk proper becomes 1–3 dm. thick. The leathery asymmetric leaves have rather obscure veins and midrib and are borne clustered at the ends of the twigs. They are sharp-pointed, oblanceolate, 12–15 cm. long and 2.5–4 cm. broad. The white flowers, 8–10 cm. broad, are borne sessile in the leaf clusters. The petals are very narrow and elongate. Though the flowers appear to be terminal, they are morphologically lateral and always adjacent to the subulate terminal bud which they crowd to one side. The distinctive beaked fruit (PLATE 12, FIG. 1) is biconvex, strongly corrugated on the sides, and generally at maturity about 1 dm. long, 8 cm. broad, and 3–4 cm. thick. In lateral outline it is top-shaped, with the body cordate, orbicular, or broadly ovate, and abruptly contracted and prolonged at the apex into a stout beak 1.5–2.5 cm. long. The tree seems to flower and fruit sporadically throughout the year. Its major crop of fruit, however, is that matured towards the end of the rainy season. In October 1944 I found the trees loaded with fruit. Most of the crop was shed by mid-November. Falling to the ground, much of it was carried out of the swamp by retreating tides and subsequently washed up on the beaches of Bodega Bay. Many of the fruits had been battered and critically damaged, many were soon stranded high on the hot sand and dried out, and others floating in quiet, shallow water had managed to start seed germination. Some carried back and left stranded in the inner parts of the swamp germinated promptly. These latter, however, were resting on their sides and not beak downward in the mud. There are statements in the literature to the effect that these fruits fall from the tree beak downward, thus affixing the fruit in a site favorable for the germination of its enclosed seed. This is contrary to fact. The heavy end of the fruit is not the pointed end. A fruit allowed to fall freely lands on its side or on its broad end. In water, however, the buoyant fruit floats with its beaked end lowermost. Since the beak sheathes the well-developed root of the embryonic plant housed in the fruit, its low buoyancy would tend to keep it in contact with the soil if the fruit were stranded in a part of a swamp that is only shallowly inundated. The fruits are obviously dispersed by tides and can be transported by ocean cur-

rents. They are, however, not well equipped for ocean dispersal, since they do not adequately protect their seed if battered against rocks or exposed to the drying sun when tossed up on beaches. The protection of the seed afforded by the fruit wall is not only poor but also of short duration. The seed usually germinates shortly after falling into the water, and soon bursts the fruit wall and even frees itself. Though large numbers of the fruits are carried into the ocean, it is probable that only rarely is one transported to a suitable destination in a condition that permits further growth and development. The species grows in mangrove swamps along the Pacific coast from Costa Rica south to western Colombia. (Fl. C. Z. p. 267). *Johnston 332, 1124; Erlanson 329.*

Ternstroemia Seemannii Tr. & Planch. MANGLILLO

A tree, 10–20 m. tall, common in the forests on the southern half of San Jose. On the northern half of the island it is local in distribution, and is present in numbers only along the road between the Cross Roads and Red Hill, along the southernmost portion of the East Loop, and along the northernmost parts of the Loop adjacent to Area 11D. A few trees were noted along Bald Hill Road just north of the grassland. A very dense growth of the tree, one readily studied, occurs along South Road near the top of the small grade less than a half-mile south of the Cross Roads.

The trunk, usually 2–6 dm. thick, is commonly irregular in cross section and frequently not straight. It is usually dark and has a rough, scabby bark. The bark, usually 12–16 mm. thick, is reddish brown or coffee-colored in section and coarse and granular in texture. The large twigs and branches develop ridges of cork about their transverse lenticels and hence appear warty. Characteristic of the tree, and useful in recognizing it, is the fact that the leafy twigs are not equally distributed along the ultimate branches. The twigs grow in crowded groups on the branches, radiating from it at intervals of 6–15 cm. The leaves, 6–11 cm. long and 2.5–5 cm. broad, are oblanceolate and coriaceous. They are broadest above the middle, acute or short acuminate at the apex, acute at the base, dark lustrous green above, and borne somewhat crowded along the outer half of the twigs. The tree renews its foliage during January. For a time at the end of that month it attracts attention. The ground beneath it is completely covered with dusky fallen leaves, and its branches, clad in bright, fresh new herbage, make it stand out against the prevailing dark green of the forest.

The flowers are produced abundantly in late February and early March. They are borne on pedicels 1–2 cm. long, produced along the leafy twigs, and have broad, rounded, overlapping white or greenish white sepals 5–7 mm. long, which surround 5 small white, yellow-tipped petals 4–5 mm. long. The brown ovoid fruit, matured abundantly in March and April, is 8–15 mm. in diameter, 1–1.5 cm. long, and commonly tipped by a slender stylar beak 2 mm. in length. In shape it resembles an inverted top or a pointed acorn. At maturity it bursts irregularly to free a number of bright red seeds 7–9 mm. long, and detaching at its base falls to the ground, leaving the pedicel and the spread calyx persisting on the top for a few weeks. The species is known only from Panama. (Fl. C. Z. p. 267). *Johnston 337, 350, 379, 409, 622, 706; Erlanson 43, 93; Campbell 8.*

GUTTIFERAE

Clusia minor L. COPEY

A small tree most common as an epiphyte in streamside forests and on wooded coastal cliffs, but at times also present as a self-supporting plant growing on sheltered rocks near the sea. Though widely distributed on the island, it is seldom noticed, since it usually develops high in trees, where it rarely attracts attention. A good example of the plant, readily observed, grows on the low cliff beyond the stream-mouth at the east end of Main Beach.

The species can be readily recognized by its very thick opposite leaves and a latex which, though at first milky, soon oxidizes to brownish. The leaves are obovate to oblanceolate, 10–18 cm. long, 4–9 cm. broad, broadest above the middle, obtuse at the apex and acute at the base. They are thick and have very numerous straight, crowded, steeply ascending primary veins. Their petiole is 8–30 mm. long. The plants are unisexual. Only male flowers were seen. They are borne singly on a simple bracted peduncle 1–2 cm. long, and have a pinkish corolla composed of 5 petals, and are 4–4.5 cm. in diameter. The fruit, 2.5–3 cm. in diameter, is nearly globose and is reddish brown and 10-celled.

A poorly understood and much confused species said to range in Central America, the West Indies, and northern South America. The San Jose plant, if not properly referable to *C. minor*, is probably unnamed. (Fl. C. Z. p. 268). *Johnston 59; Erlanson 101; Harlow 61; Andersson.*

Marila macrophylla Benth.

A tree occasional in streamside forests in all parts of the island. It grows 6–12 m. tall and develops a trunk 1.5–2.5 dm. thick. The leaves are opposite, elliptic, 15–25 cm. long, 6–11 cm. broad, obtuse or short acuminate at the apex, and obtuse or rounded at the base. The petiole is 10–15 mm. long. The primary veins are conspicuous and parallel. The flowers are borne in slender loose, elongate racemes 15–30 cm. long. The fruit is an elongate, slender capsule 3–4 cm. long and 3–5 mm. thick, which splits at maturity, freeing great numbers of tiny seeds which bear tufts of tawny hairs on opposing ends. Only two trees were found reproducing. One with mature fruit was found in the canyon north of Red Hill on April 11, 1945, and another, with flower buds ready to open, was seen along the stream in Area 11D at the end of the same month. The species is confined to Panama. (Fl. C. Z. p. 270). *Johnston 685, 763, 808; Erlanson 52.*

Vismia ferruginea HBK.

Commonly a large shrub 2–6 m. tall, but occasionally a tree up to 15 m. high and with a trunk 1–2.5 dm. thick. It is most common and conspicuous at the margin of the forest surrounding the grassland on Bald Hill, where it is frequent and usually grows as a large bush or small tree. Elsewhere on the island it is generally uncommon, usually bushy in growth, and in undisturbed places usually confined to thickets or forest margins. In 1944 the plant was observed only at Bald Hill, near the Goat Barn, near OrangeTree Beach, and at the south end of the island. By 1946, however, it had evidently increased in numbers and had become more generally distributed. At that time young plants had begun to attract attention here and there in the second growth on various parts of the island. The largest individual trees of

the species grow at the south end of the island, near the south end of Navy Cove Road, and to the west of South Beach. They are of good size, grow in the forests, and have their tops in the forest canopy, but are much less common than the shrubby forms of the species frequent there about forest margins. In the large trees the bark tends to scale off in elongate strips. When cut, the stems and trunks ooze limited quantities of an orange-colored latex. The plant is readily distinguished by having its leaves opposite, green and glabrous above, and brown and clothed with appressed hairs beneath. The foliage is broadest below the middle, 1–1.8 dm. long, 4–8 cm. broad, and borne on a petiole 1–2 cm. long. The flowers are white and borne in small loose terminal clusters.

The species ranges in Central America and northeastern South America. Though I have followed most recent botanists in treating this plant as *V. ferruginea* HBK., there are reasons for believing that it is not the correct name for this, the most common species of the genus in Central America. (Fl. C. Z. p. 267). *Johnston 19, 255; Erlanson 46, 204, 297, 356.*

COCHLOSPERMACEAE

Cochlospermum vitifolium (Willd.) Spreng. PORO-PORO

A tree, commonly 5–15 m. tall, with a small, rather open crown. It is frequent on areas of thin soil on the eastern peninsula and rather common in the forest margin fringing the grassland on Bald Hill. Individuals, some of them very stunted, are also found scattered on rocky seaward slopes, on exposed cliffs, and on the rocky islets along the coast. The plant flowers when small, frequently when only a bush 1–2 m. tall. The largest tree seen on the island was about 20 m. tall and had a trunk 3 dm. thick. When cut the bark is revealed to be thick, juicy, and more or less laminated. It gives a gray or lead-colored tight papery covering to trunks 1–2 dm. thick, but in large old trees may become shallowly furrowed. The juicy wood is soft, white, and porous.

The palmate leaves are distinctive. They are practically glabrous, 1–2 dm. broad, conspicuously 3–5-lobed, somewhat cordate at the base, and serrate on the margin. The plant begins to shed its foliage at the close of the wet season and is usually naked or nearly so by early January, and so it generally continues through the remainder of the dry season. The flowers are conspicuous, bright yellow, 8–10 cm. broad, and borne in small loose inflorescences produced on naked twigs. In varying abundance they are present almost continuously from December to April. The fruit, becoming first conspicuous in late February, is a subglobose or broadly ellipsoidal thin-walled capsule, 7–9 cm. long. At maturity it splits into 4–5 parts and frees many seeds. The latter bear an abundance of long cottony fibers and are distributed by the wind. The species is widely distributed in tropical America. (Fl. C. Z. p. 270). *Johnston 566; Erlanson 299.*

FLACOURTIACEAE

Banara guianensis Aubl.

A small, loosely branched tree 3–4.5 m. tall, occasional in thickets and along forest margins. In undisturbed places it was seen in various parts of the island, but always as very widely scattered, isolated individuals. It will

perhaps become more common. By 1946 young trees 2.5 m. tall were noted here and there at intervals in disturbed places near the roads. The leaves are 10–16 cm. long, 4–7 cm. broad, dark grayish green above, pale beneath, broadest at or below the middle, acute or short acuminate at the apex, and coarsely toothed on the margin. The petiole is 1 cm. long. Distinctive of the species are glands borne on its leaves. There is a sunken circular gland on each tooth of the blade, and a coarse, somewhat stalked gland near the junction of blade and petiole. The flowers and fruits are borne in small terminal panicles. No flowering material has been collected on the island. Erlanson collected a plant with nearly mature fruit in late July. The species is known from Costa Rica, Panama, and northern South America. (Fl. C. Z. p. 273). *Johnston 1120; Erlanson 498.*

Casearia banquitana Krause

A bush or small tree, 1.5–7.5 m. tall, frequent on areas of thin soil on the eastern peninsula. Elsewhere on the island it was observed locally on thin soil in Area 11B and on the islet off E. M. Beach. Its glabrous leaves are narrowly elliptic to oblanceolate, 5–15 cm. long, 2–7 cm. broad, acute or bluntly short-acuminate at the apex, and truncate or cordate and 6–10 mm. broad at the very base. They are rather thin and contain abundant oil cells showing as very numerous translucent microscopic dots and lines when held before a light. Their petioles are 2–3 mm. long. The foliage is shed early in March and renewed as the plant comes into flower in late April. The white flowers, nearly 1 cm. broad, are borne in small branched inflorescences along the leafy stems. The nearly globose fruit, 10–12 mm. long; has 3–4 sharp, vertical ribs and is bright yellow or orange in color. At maturity it splits, and its segments spread to free a single globular seed.

The island plant is the var. **laevis** (Standley) comb. nov., which occurs in western Mexico, along the dry Pacific coast of Central America, and in the dry areas of northern Colombia. It was originally described as *C. laevis* Standley (1923) and based upon a type collected in Sinaloa, Mexico. Typical *C. banquitana* Krause (1914) was founded upon material obtained near Corinto, Nicaragua, and has a synonym in *C. dolichophylla* Standley (1923). It differs from the var. *laevis* only in having the foliage more or less softly hairy beneath and the flowers and inflorescence usually finely pubescent. The species and variety are connected by many intergrading forms and occupy the same range from Nicaragua northward. South of Nicaragua only the var. *laevis* appears to be present. Our plant is probably most closely related to *C. corymbosa* HBK. of northern Colombia, but it is readily distinguished by its leaves, which are contracted to a narrow obtuse or cordate base and have fewer veins, as well as coarser, fewer, rounded teeth on the margin. In recent years much material of *C. banquitana* and *C. corymbosa* has been referred to *C. nitida* Jacq. That name, however, is properly applied to a plant confined to Jamaica. (Fl. C. Z. p. 274, sub *C. nitida*). *Johnston 745, 1028; Erlanson 151, 159, 255, 448, 588; Harlow 35; Campbell 11.*

Casearia guianensis (Aubl.) Urb.

A shrub or small tree, 3–6 m. tall, which has been collected on the island only four times. It was found on the northeast coast by Andersson, in Area 11A, and in Area 11B by Erlanson, and by me along the middle section of

Little Butch Trail. The plant has rather few elongate branches. The glabrous leaves, 12–18 cm. long and 4.5–7 cm. broad, are usually broadest above the middle and have an acute base, an obtuse and coarsely acuminate apex, and a toothed margin. They have numerous but very minute translucent oil cells in the tissue. The small white flowers are borne in tight clusters in the leaf axils, apparently in April and May, as the plant sheds its foliage preparatory to leaf renewal. The fruit is a fleshy capsule about 1 cm. long, which splits and spreads to display a red interior. The species ranges from Cuba and Costa Rica south into northern South America. (Fl. C. Z. p. 274). *Johnston 1139; Erlanson 94, 261; Andersson.*

Casearia myriantha Turcz.

A large shrub or small tree 5–10 m. tall, with a trunk 1–2 dm. thick; occasional in high thickets and about forest margins. It is an unobtrusive plant found in all parts of the island, but never in any local abundance. The glabrous, firm, lustrous leaves are dark green with a very distinctive brownish cast. They are broadly lanceolate, 10–18 cm. long, 3–5 cm. broad at or just below the middle, acute or rounded at the base, acuminate at the apex, and somewhat sinuate-dentate on the margin. Unlike the other species of this genus they have no translucent oil cells in their tissue. The small white flowers are borne in dense clusters in the leaf axils on pedicels 5–10 mm. long. The flowers develop very slowly, and for a month or more form dense, sessile, cushion-like masses 4–8 mm. broad along the stems. The subglobose, three-sided glabrate fruit is 5–7 mm. thick, red, and slightly fleshy. At maturity it splits into three spreading sections to free the single seed, which is invested by a pale aril.

The species ranges from Mexico to Panama. It has usually been identified as *C. javitensis* HBK., a species of the Guianas and the Amazon headwaters, which has reddish tomentose fruit that is embraced at maturity by ascending sepals. Occasional specimens have been identified with *C. Commersoniana* Camb. That species, however, is confined to eastern Brazil and differs in its sparsely flowered glomerules of coarser flowers, accrescent sepals, larger fruit, and proportionately less elongate, shorter leaves which have 3–5 rather than 5–8 pairs of principal veins. The type of *C. myriantha* was collected at Chagras, Panama, by Fendler, no. 185. The species is a very distinct one, and it is surprising that it has gone so long unrecognized. (Fl. C. Z. p. 274, sub *C. javitensis*). *Johnston 241, 354, 1347; Erlanson 54, 137, 312.*

Casearia sylvestris Sw.

A small tree or large shrub, 3–10 m. tall, occasional in high thicket, along forest margins, and in open forests, chiefly in the eastern half of the island. The main trunks may become a decimeter or slightly more in thickness. The lustrous, dark green leaves, 7–12 cm. long and 2–4 cm. broad, are lanceolate, broadest below the middle, broadly acute and somewhat asymmetric at the base, slenderly acuminate at the apex, and nearly entire on the margin. In the common forms of this species they are glabrous and contain numerous minute oil cells in their tissue which are not only translucent but also evident as obscure swellings on the lower surface. The flowers, 2–3 mm. broad, are pale yellow, borne on slender pedicels 2–3 mm. long, and crowded in dense clusters along the leafy twigs. They usually have a strong, somewhat offensive odor.

The species is widely distributed in tropical America. The common form on San Jose is indistinguishable from typical *C. sylvestris* from Jamaica. This plant has glabrous flowers, pedicels, and inflorescences, and subglobose flower buds. It was found in flower in November. A flowering plant collected in February in Area 11A seems referable to the var. *lingue* Rich. This variety differs from true *C. sylvestris* in having a conspicuously pubescent inflorescence, pubescent, more elongate flower-buds, and far fewer translucent oil cells that cause no swellings on the lower leaf surface. Its pubescent, narrowly obovoid flower buds, more deeply perigynous flowers, and much more elongate sepals and staminodes are especially notable. It may represent a distinct species. Plants referable to the variety have been found throughout the range of the species. Those growing within the range of true *C. sylvestris*, from Mexico to Costa Rica, agree very closely with the form of the variety found on the island. (Fl. C. Z. p. 274). *Johnston 232, 278, 345, 416, 1334.*

Casearia StJohnii, sp. nov.

Arbor 3–12 m. alta; ramulis cortice inconspicue minuteque pubescenti obtectis: ramulis sterilibus robustis ad 5 dm. longis 3–5 mm. crassis cortice saepe pallido donatis, vetustioribus non rariter spinescente breviterque ramosis (spinis divaricatis validis 1–3.5 cm. longis); ramulis florigeris 1.5–2.5 dm. longis gracilibus 1–2 mm. crassis cortice griseo obtectis; foliis ramulorum floriferorum obovatis vel obovato-ellipticis aequilateralibus 6–8 cm. longis 3–4.5 cm. latis conspicue 8–15 mm. longe petiolatis laete viridis contra lucem validam distincte punctatis secus petiolum et costum et nervos perinconspicue adpresseque pubescentibus alibi glabris, margine haud vel vix revolutis plus minusve distincte crenatis, supra lucidis, basi acutis, apice rotundo-obtusis in acumen latum 4–7 mm. longum productis; nerviis primariis utrinque, ca. 5 arcuato-ascendentibus; foliis ramulorum sterilium majoribus plus minusve ellipticis 8–12 cm. longis 4.5–6.5 cm. latis 5–10 mm. longe petiolatis, nerviis utrinque 5–7; fasciculis floralibus densis ad nodos foliatos ramulorum juniorum sessilibus 8–15-floris; pedicellis 1–2 mm. longis, 0.2–0.5 infra apicem articulatis; bracteis confertis 2–3 mm. longis et latis firmis persistentibus quam pedicellis saepe longioribus apicem versus pallide strigulosis; alabastro floris subgloboso; calyce extus minute adpresseque pubescenti, intus glabro vel sparsissime striguloso, tubo brevissimo vix differentiato; staminibus 8 basi in tubo glabro ad 0.5 mm. alto coalitis; filamentis filiformibus glabris 1.5–1.8 mm. longis; antheris oblongis ca. 0.5 mm. longis; staminoideis 8 elongato-oblongis conspicue albido-pilosis ca. 1 mm. longis ca. 0.4 mm. latis; ovario piloso gradatim attenuato ca. 2 mm. longo basi ad 1 mm. crasso; stigmate conico-capitato; fructu ignoto.

TYPE: *Erlanson 369*, San Jose Island, Area 11A, tree 9 m. tall.

A large shrub or tree, 3–12 m. tall, growing in high thickets or in open forest. It appears to be rare. Single individuals were observed in Area 11B, near the south end of the East Loop, in Area 8B, on the west boundary of Area 8A near East Road, on Playa Grande Jeep Trail, and along South Road near the fork to Max Point. The bark is smooth and pallid. The branches and vigorous shoots frequently have stout, spreading, spinescent twigs 1–3.5 cm. long. The leaves are light green and lustrous above, obovate, usually 6–8 cm. long, 3–4.5 cm. broad, crenate-toothed on the margin and borne on a slender petiole 8–15 mm. long. The small greenish yellow flowers are produced in dense groups in the leaf axils, apparently during late June and July.

The species is known only from San Jose Island. Among its distinctive characters are the very dense sessile glomerules composed of coarse bracts and short-pedicellate flowers and the long-petiolate glabrous obovate leaves of fertile twigs. Notable also are the stout divaricate spinescent twigs developed on the vigorous sterile shoots and older branches. It is a member of the section *Pitumba* and is most closely related to the plant of Mexico and Central America that has been improperly identified with *C. aculeata* Jacq., but it is readily distinguished from the latter by the coarse bracted inflorescence, short-pedicellate flowers, and coarse spinescent twigs. Its continental relative, which appears to be unnamed, is separable from true *C. aculeata* Jacq. by its long-petiolate obovate leaves, sparsely hairy or glabrate twigs, and more herbaceous, less persistent bracts. Two authors have indicated that the name *C. nicoyensis* Donn. Sm. was applicable to it, but that is incorrect. Smith's binomial belongs in the synonymy of *C. arguta* HBK. The new species from San Jose has been associated with the name of Colonel Adrian StJohn, Commanding Officer on the island during my third visit there in 1946. *Johnston 1257; Erlanson 274, 369.*

Hasseltia floribunda HBK.

A large shrub or small tree, 3–10 m. tall, which is occasional in high thicket and in open forests along the northern half of the East Loop, along the road for about a half-mile east of Red Hill, and along the road west from South Beach. The nearly elliptic, strongly 3-ribbed, nearly glabrous light green leaves are 1–2 dm. long, 5–10 cm. broad, rounded at the base, obtuse and acuminate at the apex, and coarsely and irregularly serrate on the margin, especially above the middle. Distinctive of them is a pair of glands present on their upper surface adjacent to the slender petiole. The latter is 1.5–3 cm. long. The inflorescence is flat-topped, much branched, and 10–15 cm. broad. The numerous small white flowers have many exserted stamens and reflexed petals and sepals. They seem to be produced most abundantly during March. The fruit is a purplish or reddish globose berry about 6 mm. in diameter. The species ranges from Nicaragua to Colombia. (Fl. C. Z. p. 272). *Johnston 372; Erlanson 380.*

Xylosma intermedium (Seem.) Tr. & Planch.

A bush 1 m. high or a shrub with very few very elongate, sparingly short-branched stems which, where supported by other vegetation, can reach 8 m. in height. It grows at forest margins and in open woods and, though generally distributed on the island, is rare there. The plants were seen, in most cases as single individuals, at Bald Hill, at the south end of the East Loop, near East Harbor, at the east end of Mango Beach Jeep Trail, near South Beach, near the bridge at the Goat Barn, on the hill southwest of Camp, and in Areas 8B, 8D and 11A. The largest plants had stems 2–4 cm. thick near the ground. Usually present along the stem, and very distinctive of the species when present, are stiff, sharp, smooth, slender, frequently branched spines, 1–5 cm. long and 1–2 mm. thick. Some plants are spineless, but the great majority of those seen had spines in conspicuous abundance along the lower and older stems and frequently along the vigorous new shoots also. The glabrous leaves are lanceolate, 7–13 cm. long, 2.5–4 cm. broad, obtuse at the base, contracted into a slender acumination at the apex, and broadest at

or slightly below the middle. Their margins are regularly and evidently sinuate-dentate from apex to base. The teeth bear minute marginal glands. The petiole is 3–6 mm. long. Flowers were seen only once, in late April, on plants near the Goat Barn. These were male, greenish yellow, and borne in compact small clusters along twigs of a plant shedding its leaves. The species is known only from Costa Rica and Panama, but is closely related to, and perhaps not always separable from *X. nitidum* (Hell.) Gray of Jamaica and Trinidad. (Fl. C. Z. p. 273). *Johnston 524, 778.*

Zuelania Guidonia (Sw.) Britt. & Millsp.

A tree 10–20 m. tall, with an elongate pale cylindrical trunk 2.5–6 dm. thick, and a broad low-domed crown. The tall pallid trunk and the shallow wide crown give it a distinctive appearance, especially so during the dry season, when it is leafless. It is found as scattered individuals standing in thickets or growing along forest margins and in open woods in all parts of the island. Good examples of the tree, readily observed, may be seen on the thickety slope between Motor Pool and Headquarters.

When freshly cut the thick bark is tan and marked with dark streaks, but it soon changes to mustard color and begins oozing a clear, yellowish exudation. The twigs are slightly reddish and roughened with somewhat protruding transverse lenticels. The elongate leaves, 15–25 cm. long and 5–9 cm. broad, are displayed horizontally along the sides of the twigs. They are green above, grayish or slightly brownish and somewhat hairy beneath, acute at the apex, rounded or obtuse and slightly asymmetric at the base, and broadest at or just above the middle. Their petiole is 1 cm. long. The foliage is shed early in February and generally not renewed until late in the dry season. The yellowish flowers, 1 cm. broad, have numerous stamens and more or less deflexed greenish petals. They are borne in terminal globose clusters 3.5–4.5 cm. in diameter, usually when the tree is nearly leafless, during late February and early March. The fruit is depressed globose, 2.5–5 cm. broad, 1.5–3 cm. high, and dark green in color. It is firm but somewhat juicy in texture, produces honey-like exudations when bruised, and eventually splits into three broad diverging parts to expose the seeds and the conspicuous orange placentas. The species is known from the Bahamas, Cuba, Jamaica, eastern Mexico, British Honduras, and Panama. (Fl. C. Z. p. 273, plate 55, sub *Z. Roussoviae*). *Johnston 427, 515, 611, 613.*

TURNERACEAE

Turnera ulmifolia L.

A single plant, coming into full flower, was found growing under a *Hibiscus* hedge at Camp in mid-February 1946. It was a sprawling herbaceous plant with strigose stems and foliage, dentate leaves, and a bright yellow corolla 3–4 cm. broad. The species is widely distributed in tropical America, but is evidently not a native on the island. *Johnston 1374.*

PASSIFLORACEAE

Passiflora biflora Lam.

A vine with tendrils and strongly ribbed slender stems; occasional in dry open forests and in second growth along roads. The leaves are of unusual form, being composed of a pair of rounded diverging lobes broadly joined at

the base, and hence more or less moon-shaped. They are 4–9 cm. broad, usually distinctly broader than long, and always have 3 strong straight ribs diverging from the rounded base. Flowering and fruiting occurs during the dry season. The flowers, 3–3.5 cm. broad, are borne one or two together in leaf-axils. The petals are green outside and yellowish on the inner surface. The fringed corona is green with yellow tips. The fruit is globose and 1–1.5 cm. broad. The species is widely distributed in the American tropics. (Fl. C. Z. p. 275). *Johnston 549, 809, 1189; Erlanson 183, 219.*

Passiflora

A vine with tendrils, climbing thickets and forest margins, and occasional in all parts of the island. The leaves are palmately 3-lobed, glabrate, 8–14 cm. long and nearly as broad. They are somewhat cordate at the base and have sharply pointed lobes. No flowering nor fruiting plants have been collected. I found the plant most conspicuous during January and early February 1946, when it was in its period of maximum vegetative activity and its fresh green, rapidly elongating leafy stems contrasted in color with the vegetation supporting them. I suspect that flowering occurs during the last of February and early March, when no botanizing has been done on the island. *Johnston 1402.*

CARICACEAE

CARICA PAPAYA L. PAPAYA

Plants of papaya grow here and there along some of the roads on the island. Accounts of their origin vary; according to some they volunteered at the roadside in a manner similar to the balsas, but, according to others, they grow from seeds, and in some cases seedlings, brought from the Isthmus by the Engineers. In October 1944 rapidly growing young papayas 3–18 dm. tall were observed at various places along the new roads of the island. No old plants were found, and there were no reports that mature papayas existed on the island when the Army took possession of San Jose early that year. A few of the young plants observed in October 1944 may have been deliberately planted, but most of them probably sprang from seeds of fruit brought to the island by the Engineers or their laborers. The species is a cultivated plant of American origin unknown in the wild state. (Fl. C. Z. p. 276). *Erlanson 222.*

BEGONIACEAE

(Identifications by Bernice G. Schubert)

Begonia filipes Benth.

An erect, juicy, annual herb 15–45 cm. tall, with red ascendingly branched leafy stems. The leaves are oblique, 3–7 cm. long, 1.5–3 cm. broad, and coarsely and irregularly toothed. The petiole is 5–10 cm. long. The clusters of small white flowers are borne along the leafy stems. The fruit has a lateral wing much wider than high. The plant was found in great abundance on the steep wet north slope of Red Hill and locally in less abundance along the Marino in Area 7A and in the forested valley in Area 11B. It grows rapidly during the wet season, flowers and fruits in October and November, and is dried up and dead by the end of December. The species ranges from Nicaragua to Panama. (Fl. C. Z. p. 277). *Johnston 108.*

Begonia plebeja Liebm.

An herbaceous plant common on mossy rocks and tree trunks in shaded streamside forests, and occasional about seepage-wet rocks on sheltered slopes and cliffs. The creeping perennial stem is thick and scaly. The leaves, 8–18 cm. long and 5–12 cm. broad, are palmately ribbed and more or less ovate, and have an oblique cordate base and an irregularly dentate and denticulate margin. The petioles are 1–2 cm. long. The flowers are pink or rarely white and are borne in a forking cyme elevated on an elongate peduncle that springs from among the leaves. The species comes into general flowering near the end of October, and for some weeks it is an attractive feature in streamside forests. The pods, which have a lateral wing higher than broad, are numerous by the end of November. The plants rest during the dry season. Most of them have their leaves and inflorescence dried up and shed by early January. The species ranges from Mexico to Panama. *Johnston 83, 207, 322, 386, 436.*

CACTACEAE

Cereus costaricensis (Weber) Berger

A common species on barren rocks, islets and cliffs along the coast, and frequent as an epiphyte, especially on the branches of *Bombax quinatum,* in the interior of the island. On many rocks and islets along the shore it is the most conspicuous plant. Masses of its dangling stems are features on barren cliffs and headlands. The plant varies in its form and appearance according to its particular habitat. On flat exposed rock surfaces it may be compact in growth, 1–3 dm. tall, and composed of short, stout, decumbent or ascending stems 3–6 cm. thick. Stems dangling from high branches or from the top of cliffs are usually only 1–3 cm. thick but may become several meters or even more in length. Stems rooted on branches become flattened, as much as 10 cm. broad, and tend to wrap themselves about the support. The plant has typically 3-angled stems, but rarely 4-angled ones may be found. The areoles are 3–5 mm. in diameter and produce 4–7, but most commonly only 5–6, stout thorns 2–4 mm. in length.

Erlanson collected the plant in flower at Main Beach on May 18, 1945. I kept the species under observation during all months from late September until the first of May, but never found any plants with fruit, flower, or buds. Like the other cacti on the island, it flowers, apparently, only at the beginning of the rainy season. The large, white, showy flowers are funnelform and 2.5–3 dm. long. The species is known only from western Costa Rica and Panama. *Johnston 1226; Erlanson 172.*

Cereus pentagonus L.

Frequent here and there on cliffs and barren rocks along the ocean. Though it may be present in great local abundance, as on the outer headland of Punta del Cabo, it usually grows in rather inaccessible places where it is not readily observed. One good stand of it, however, can be easily visited on the islet off Long Beach. Transplanted individuals may be seen about the buildings at the Cross Roads. The plant grows 1–2.5 m. tall and has erect or ascending stems 5–6 cm. thick. There are 5 or 6 (rarely 3–4) ribs on the stems, each well armed by clusters of 5–6 conspicuous thorns. The large central thorn in the cluster is 4–7 cm. long. The flowers of this species (which is re-

ported to be white and 15–20 cm. long) has not been collected on the island. Flowers are probably produced at the beginning of the rainy season. Certainly I found no flowers, buds, nor fruits on this species during my work on the island between the end of September and the first of May. The species is confined to the West Indies and Central America. (Fl. C. Z. p. 279, sub *Acanthocereus pentagonus*). *Johnston 1181.*

Opuntia elatior Mill. PRICKLY PEAR

Found in very limited numbers at only two places on the island. A few plants grow at E. M. Beach, on the flat tops of some large rocks surrounded by water at high tide, and others grow on barren rocks on the islets lying off Long Beach in Bodega Bay. The plants are small, 3–10 dm. tall, and have flat joints up to 2 dm. long and 15 cm. broad. They are well armed with slender brown thorns mostly 2.5–5 cm. long. The yellow flowers, about 5 cm. broad, were collected by Erlanson on May 18, 1945. Though the plants had been observed during all months from late December to the first of May they neither bore fruit nor gave any evidence of flowering during that period. The species is known from Panama, Colombia, and Venezuela. (Fl. C. Z. p. 278). *Erlanson 171.*

LYTHRACEAE

AMMANNIA COCCINEA Rottb.

In January 1946 over a dozen flowering plants of this species were found growing about the Goat Barn. The species is native to the United States and was doubtlessly introduced onto the island in unclean hay, probably grown in Texas and shipped from New Orleans. *Johnston 1239.*

CUPHEA CARTHAGENENSIS (Jacq.) Macbr.

On January 1, 1946, this species was an occasional weed in the lawn at Main Camp. It is a weedy species, widely distributed in the American tropics and obviously a recent introduction on San Jose. (Fl. C. Z. p. 280, sub *C. Balsamona*). *Johnston 988.*

Cuphea elliptica Koehne

Collected near the Navy Station by Erlanson on July 22, 1945. I searched for the plant the following December but found no trace of it. The plant much resembles the preceding species but differs in technical details of inner floral structure. The species is a rare one and is known only from a very few collections made in Mexico, Central America, and Colombia. I am indebted to Dr. R. C. Foster for his aid in identifying this and the two preceding plants. *Erlanson 499.*

Rotala mexicana C. & S.

An aquatic herb with elongate stems and crowded pale green, slender, opposite leaves, which grows in a large pothole dissolved out of bedrock in the area of thin soil at East Harbor. During the rainy season the pothole remains full of water and supports a luxuriant growth of this floating plant. The hole dries out by the end of December, when I found the plant deeply matted over its bottom and flowering and fruiting in very great abundance. The minute capsules are slightly reddish. The species has a very wide distribution in the tropics. (Fl. C. Z. p. 281). *Johnston 830; Erlanson 459.*

LECYTHIDACEAE

Gustavia superba (HBK.) Berg MEMBRILLO

A tree, usually 3–10 m. and rarely up to 15 m. tall, which bears its very large leaves crowded towards the ends of its relatively few ascending branches. It is abundant only in the bottom-land forest in Camp Valley. There fine individual specimens are to be seen near the Motor Pool, along the Cut Off, and along the road to Englishman Beach. Its great leaf clusters are distinctive features in the forest canopy to be viewed west of the main road just outside of the Camp Area. Away from Camp the tree is fairly common only in the valley in Area 11B. Elsewhere small colonies were noted only at the west end of Canyon Road, near the coast west of Area 8D, and north of the west end of the Air Strip.

The leaves, the largest simple leaves produced by any plant on the island, grow crowded at the outer end of the usually elongate branches. They are glabrous, dark green, oblanceolate, commonly 6–10 dm. long and 10–24 cm. broad, broadest between the middle and apex, and gradually contracted towards the base. Their apex is broadly acute to slenderly acuminate, and their margin is finely to coarsely toothed. The petiole is usually 2–5 cm. long but on a single plant may vary from 1–7 cm. in length. The foliage, like the fresh bark and wood, has an unpleasant odor when crushed. This odor, intensified, is given off by specimens drying in a plant press. In 1944, during the construction of the Cut Off, many trees of *Gustavia* were uprooted and dumped in piles at the roadside. As this mass of vegetation wilted, sweated, and decomposed, the offensive odor pervaded the neighborhood. Two Venezuelan species are reported to be similarly malodorous; one, indeed, is said to give off in decomposition an odor suggestive of a putrefying cadaver and to be actually called "Palo de Muerto."

The trunk of the tree becomes 1–2 dm. thick. Its wood is heavy, dense, and white. The leaf-bearing ends of the branches are commonly 1–2 cm. thick and usually lengthen less than 15 cm. annually. Vigorous ones develop a large terminal bud at the beginning of the dry season. Most branches are marked at intervals with bands of very crowded attachment scars of former leaves and bud scales, which clearly delimit the annual increment of growth for a goodly number of previous years. It is thus possible to state that some of the lowermost leaves in the leaf cluster do function for several years. The large terminal vegetative bud is an unusual development for a tropical tree. In their general appearance and in their behavior during unfolding, these buds of *Gustavia* are very similar to those produced by that North American deciduous tree, the Shagbark Hickory. They are, however, produced by a tropical tree in full leaf that holds its foliage for several years. When well developed, the terminal bud becomes 15 mm. long and 8 mm. thick and is sharp-pointed and tightly invested by tough outer bud scales. In December it swells, elongates, and loosens, and becomes 45 mm. long and 20 mm. thick. As the new shoot it contains starts rapid elongation, the inner bud scales rapidly lengthen and broaden to become as much as 15 cm. long and 3 cm. wide. These large inner bud scales are red or crimson in color and usually become widely spreading or recurved before falling. They are conspicuous on the trees for only a week or so about the end of December. The new shoot does about 90 per cent of its lengthening during January and grows very

slowly during the remainder of the year. The fresh green of new leaves is conspicuous on the trees in January, the month when there is apparently the greatest amount of leaf fall.

The large flowers, with sturdy pedicels 4–5 cm. long, are borne in short stout leafless inflorescences produced in large numbers on the naked branch just below the terminal leaf cluster. Frequently a meter of the branch is covered with crowded masses of buds and flowers. The inflorescence is at first umbellate, but as the flowers mature, usually one at a time, it usually elongates and becomes racemose and up to 1 dm. long. The conspicuous flowers are delicately fragrant, 8–10 cm. broad, and composed of 8 (or rarely 10) large oblong-obovate pink petals. The stamens are very numerous and form a corona at the center of the flower. They are united into a saucer-like tube below the middle. Above the middle they are free and in the aggregate form a delicately colored fringe, grading from pink to violet, which arches inward concentrically. The period for general flowering appears to be in late May and in June. Individual trees, however, were observed in flower at various times from October to May, but none set fruit.

The fruit is depressed globose, 5–10 cm. in diameter, and brown when mature. The flesh is very firm, orange in color, and surrounds a number of large rough irregular brown seeds. One tree bearing several mature fruits was seen in February and another one with submature ones was found in late April. Erlanson collected mature fruits in July, the month when it probably becomes common. The fruit is said to be edible, but I did not find it very palatable. Since *Gustavia* is a relative of the plant producing the Brazil Nut the seeds were tasted. They had a most unpleasant and very persistent bitter taste.

The species is well known only from the Canal Zone and adjacent portions of Panama but agrees very closely with the original description of *G. superba*, based upon a plant collected near the mouth of the Magdalena in northern Colombia. I have seen no material from Colombia, nor can I find any indubitable records of its having been subsequently found there. (Fl. C. Z. p. 282). *Johnston 282, 961, 1395; Erlanson 495.*

LECYTHIS sp.

About a dozen specimens of the woody fruit of an unrecognized species of this genus were found washed up on the beaches of Bodega Bay during January and February 1946. They consist of the pyxis, empty of seeds and devoid of the operculum. They are notable for being evidently broader than high, varying in size from 7 cm. high and 10–11 cm. in diameter to 5 cm. high and 8 cm. in diameter. They agree in form with none of the "monkey pots" illustrated by Miers or by Pittier, and may represent the fruit of some yet undiscovered species, possibly from the west coast of Colombia. I believe they did not come from trees growing on San Jose.

RHIZOPHORACEAE

Cassipourea elliptica (Sw.) Poir.

A common and characteristic forest tree on the southern half of the island. It was not seen north of the Cross Roads. Most trees are 10–15 m. tall, but occasionally large old specimens may approach 20 m. in height. The trunk, usually 1–2 dm. or rarely as much as 3 dm. thick, has a pallid, tight, rather

smooth bark marked at intervals of 3–10 cm. with more or less distinct transverse bands. These bands on the trunk, very useful in identifying the tree, are much enlarged and persistent attachment scars of the opposite leaves and date from the time when the tree was a sapling.

The opposite leaves are rather variable in size and shape but are usually elliptic to lance-elliptic, 6–14 cm. long, 2–6 cm. broad, and pointed at both ends. They are glabrous and frequently have a few teeth on the margin. The petiole is 3–5 mm. long. The small white flowers, notable for having hairy lacerated petals, are borne crowded along the leafy twigs on pedicels 2–4 mm. long. The fruit, a rounded, ellipsoidal, or ellipsoidal-globose capsule 6–10 mm. long, splits at maturity into 3 recurving sections to free the 1–3 seeds. The seeds have a white aril. The plant seems to do its principal flowering during the rainy season, perhaps with peaks of abundance at the beginning and end of that season.

The species is widely distributed in Central America and the West Indies. The Central American trees have been distinguished under the name of *C. podantha* Standl., but I have been able to find no characters that separate it from true *C. ellipticum*, a species originally described from Jamaica. (Fl. C. Z. p. 284). *Johnston 112, 114, 233, 340, 421, 558; Erlanson 65, 203, 390, 472, 514; Harlow 16.*

Rhizophora brevistyla Salvoza MANGROVE

A shrub with numerous stems and a rounded crown 2–6 m. tall arising from a loose scaffolding of branches supported above the highest tide by great numbers of stilt roots; or a tree up to 20 m. or more tall, with a large lofty crown elevated on a single large cylindrical trunk which is supported and braced at its base by ponderous prop and stilt roots. It is confined to coastal swamps periodically flooded by incursions of ocean water. The shrubby form of the species is most abundant and widely distributed on San Jose. It dominates the large swamp at the mouth of the Rio Mata Puerco and is the only form of the species found there. Smaller but noteworthy stands of it occur at the head of Navy Cove, on the seaward margins of the swamps at Playa Grande, and along the inlet at the end of Canyon Road. Small colonies of it were seen at a number of other places along the coast. In form of growth and general appearance and habits it is very similar to the common and well-known Mangrove of the West Indies. The arborescent form of the species was seen at only three places. It is locally abundant in the inner parts of the swamps at Long Beach and Playa Grande and present in limited numbers in the swamp back of the east end of Main Beach. The finest specimens grow in the inner parts of the swamp, where there is a steady supply of stream water and apparently only moderate flooding by tidal waters. Such specimens develop a cylindrical trunk 3–7.5 dm. thick, which is raised above the swamp mud on heavy stilts and braced by massive prop roots up to 2.5–3.5 m. above the ground. Above the most high-reaching prop root, the trunk, with slight decrease in diameter, may arise 7–12 m. before branching. At Playa Grande this form dominates in places and forms a forest with a dense high canopy. At first sight this bears little resemblance to the thickety growth of the common well-known bushy type of Mangrove. However, the stilt and prop roots that buttress and support the base of the large

trunks, though much more massive than those of the common Mangrove, do have the familiar curves and forks of the latter, and like them form a handicap for the traveler in the swamp for a distance of 2–4 m. about each tree. The great trees have no stilt roots supporting their branches, but do occasionally produce cane-like aerial roots up to several meters long that hang stiffly from the branches 10–15 m. above the swamp. On less lofty trees these would become the stilt roots produced so abundantly by the branches of the trunkless bushy form of the species.

The tree has thick, lustrous, apparently veinless opposite leaves, usually 10–15 cm. long and 4–8 cm. broad. The small yellowish flowers are borne in cymes. These latter are repeatedly forked, bearing commonly 20–50 flowers, and only rarely fewer. There is apparently some correlation between the growth-form of the plant and the number of flowers in its cymes. Some very small bushes on the tidal flat at OrangeTree Beach had only 4–6 flowers. The large bushes in the Mata Puerco Swamp near the Goat Barn had 10–30 flowers. The arborescent form of the species at Long Beach had 30–50 flowers in the inflorescence.

The real fruit is a brownish, leathery berry, 2.5–3.5 cm. long, 1–1.5 cm. thick, and bears four thickened and recurved persisting sepals at its base. While the fruit is still attached to its mother plant a seed within it germinates, pushes a primary root out through the fruit-apex, and continues to elongate until it is 4–6 dm. in length. This developing young plant, mostly elongate root, sharp-pointed and thickened at the lower end, dangles from the branch for a lengthy period before it matures, detaches itself, and falls from the mother plant. It may plunge plummet-like into the mud and there start independent growth, or, failing in this, as it usually does, float away on the retreating tide and be stranded where conditions may perhaps be suitable for its further development. Among the very great numbers set free annually, it is obvious that only the very rare, occasional, young Mangrove plant ever gets successfully established in conditions suitable for further growth and development. Almost all of them are unsuccessful. Many are washed out to sea. Battered, dead, or moribund, stick-like young Mangrove plants are to be found commonly in the drift on the beaches of the island. In October 1944, in the cove east of Punta del Cabo, I found them piled up in windrows on the beach, apparently as collected drift blown in by the prevailing southerly winds of that season.

The species ranges along the Pacific coast from Panama to Ecuador. It is one of the two species of the genus along the tropical west coast of America. Traditionally these have been referred to *R. Mangle* L., but as Salvoza, Univ. Philippines Nat. & Appl. Sci. Bull. **5:** 189–237 (1936), has indicated, that species is confined to the Atlantic and Caribbean coasts of America, from Bermuda, Florida, and Mexico south to northern Colombia and eastern Brazil, and is absent from the Pacific coast. The common Mangrove along the Pacific coast from Lower California at least to Panama appears to be inseparable from the plant of Polynesia, and hence is properly called *R. samoensis* (Hochr.) Salvoza. It is related to *R. Mangle*, but is sharply distinguished by its smaller flowers and shorter style. Our plant, *R. brevistyla*, originally described from collections made at Bella Vista, Panama, agrees with *R. samoensis* in floral structures but differs in having, not 1–5 flowers in a small cyme, but rather 10–50 flowers in a large, very much branched cyme.

It apparently replaces *R. samoensis* in western Colombia and Ecuador and includes the giant arborescent Mangroves of the Guayaquil Estuary described and commented upon by Guppy, Eggers, Hieronymus, and Sodiro. In its bushy form *R. brevistyla* is similar in habit to that characteristic of *R. samoensis*. Unlike *R. samoensis*, however, it appears to have the ability of developing into a giant tree. In addition, its seedling plants appear, on the average, to develop a longer radicle. In many respects our plant much resembles *R. racemosa* Meyers, of West Africa and the northern coast of South America, particularly so in its large, much branched cymes and its frequent development of arborescent form. It is, however, readily distinguished from *R. racemosa* by its short style and smaller, less united non-cupulate bracts of the inflorescence. (Fl. C. Z. p. 283, sub *R. Mangle*, in pt.). *Johnston 253, 1357; Erlanson 13; Harlow 33.*

COMBRETACEAE

Combretum secundum Jacq.

An occasional high-climbing woody vine which seems to be most common on the northern half of the island and best developed within a half-mile of the coast. The best growths of it were found in the woods back of Englishman Beach, in the thickets and woods near the Goat Barn, in the forest near the crest of Red Hill Grade, and in the thickets and dry woods in the general vicinity of East Harbor. The opposite leaves, 7–13 cm. long and 3–7 cm. broad, are broadest slightly below the middle and have an acuminate apex and an obtuse base. Viewed under a lens their lower surface is sprinkled with gland-dots. The yellow flowers have conspicuous protruding stamens and are borne in dense stiff one-sided racemes crowded at the ends of short branches. They make a very conspicuous display in late December and early January. The fruit, first becoming noticeable in late December, is about 15 mm. long and has four divergent, papery, vertical, lateral wings. It is at first red and finally becomes purple at maturity. When abundant it can make a display almost as colorful as the flowers.

In the vicinity of East Harbor the vine is deciduous. In late March and early April 1945 the vines on the trees near the Rock Crusher were entirely leafless, but conspicuous because of the very great abundance of dry brown fruits still attached to the stiff divaricate branches of their inflorescences. These same vines were in leaf and abundantly flowering at the end of the following December. During January 1946 they developed new growth. Leaf fall, however, began early in February, had become very pronounced by the middle of the month, and was probably complete by the first of March. This behavior of the vines near the Rock Crusher may be associated with the fact that they were growing in an area of thin soil where soil moisture is greatly reduced or wanting during the rainless season. Unfortunately I have no notes on the behavior of the vine at other stations during the dry season of 1945. It is my recollection, however, that they did not shed their foliage. During 1946 vines in areas away from thin soil were still holding their leaves and sending out vigorous whip-like twining shoots up to the time of my departure on February 19th.

The species is found in Mexico, Central America and northern South America. It has been customary to refer the Mexican and Central American plants

to *C. farinosum* HBK., but I have been unable to separate them from that much older species *C. secundum* Jacq., which was originally described from material collected at Cartagena, Colombia. (Fl. C. Z. p. 285, sub *C. farinosum*). *Johnston 617, 813, 908, 1098, 1247.*

Conocarpus erecta L. BUTTON MANGROVE

A shrub or small tree, 2–10 m. tall, frequent about the drier margins of mangrove swamps and on sand and shingle of the higher portions of sheltered beaches flooded only during storms and the highest tides. It has thickish lanceolate leaves which are 6–9 cm. long, 1–3 cm. broad, and are pointed at both ends. The inconspicuous flowers are aggregated into heads 5–7 mm. in diameter, which are borne in small terminal panicles. The fruit is matured in brown scaly balls, 8–10 mm. in diameter, which are usually present on the plant at all seasons and are an aid in identifying it. The species is found along the coast throughout tropical America and is present also on the coast of West Africa. (Fl. C. Z. p. 284, plate 59). *Johnston 339; Erlanson 100; Harlow 36.*

Laguncularia racemosa (L.) Gaertn. WHITE MANGROVE

A shrub or tree, 3–15 m. or more high, growing in coastal marshes and on usually sheltered shingle beaches where its roots are shallowly flooded during high tides. Though present at many places along the coast it seldom attracts attention. The isolated trees growing on shingle, scattered along the line of medium high tides, in Navy Cove are mostly this species. Groves of it are present on the broad shingle beach at the end of Canyon Road and on the mud flats at the west end of OrangeTree Beach. The finest stand of the plant, however, is that in the extensive swamp forest at the mouth of the Rio Marino. Here it grows with scattered *Avicennia nitida* and occasional small trees of *Mora*, and is the overwhelmingly dominant tree in the forest. Individuals are mostly 10–15 m. and occasionally even 20 m. tall and develop trunks generally 1.5–2.5 dm. and at times as much as 6 dm. thick, breast high. The bark is furrowed, firm and rather fibrous. The environmental conditions in this forest at the mouth of the Marino are esturine. The mucky, constantly wet soil found there is daily flooded by various admixtures of stream and ocean water.

The thickish opposite leaves, 6–10 cm. long and 2–4 cm. broad, are elliptic or oblong-elliptic and are rounded or obtuse at the ends. The petiole is 1–2 cm. long. The small white flowers are borne in branched terminal racemes and appear, apparently, at the end of the dry season. The fruit is green, elongate, about 15 mm. long and 5 mm. thick, and is matured during the first half of the rainy season. The species is widely distributed along the tropical coasts of America and is also present on the coast of tropical West Africa. (Fl. C. Z. p. 285). *Erlanson 202, 431, 471; Harlow 56.*

Terminalia Catappa L.

A young flowering and fruiting plant of this tree, less than 3 m. tall, grows next to the cliff at the head of a beach just north of South Beach. The large leaves are obovate, 15–30 cm. long and 8–16 cm. broad above the middle. The inconspicuous white flowers are borne on slender racemes up to 15 cm. long. The distinctive biconvex fruit has sharp margins and is 5–6 cm. long,

3–4 cm. broad, and 1.5–2 cm. thick. It floats and is well adapted for ocean dispersal. Perhaps a dozen much worn specimens, with the tough smooth epidermis destroyed and the fibrous under layers exposed, were observed, at one time or another, among the drift cast up on the beaches of Bodega Bay. There is every reason for believing that the tree near South Beach originated from the seed in such an ocean-borne fruit.

The species is a native of the East Indies, where it is widely distributed along coasts. It is much used as a shade tree at low altitudes in the American tropics, where it frequently becomes naturalized. Its fruit, containing an edible seed, has been reported as occurring in West Indian beach drift. (Fl. C. Z. p. 284). *Johnston 291; Erlanson 524.*

MYRTACEAE

Calycolpus Warszewiczianus Berg

A shrub or small tree widely distributed on the island. It is occasional in high thickets, but is most common and best developed in forests, where it grows as an understory tree. In the forest shade it is usually 3–6 m. tall. Occasionally, however, it may attain about 15 m. in height and even have its crown in the forest canopy. The trunk becomes 5–30 cm. thick, and like its branches has a very smooth, tight bark, mahogany to chocolate brown in color. In its hard, dense wood and very smooth brown bark the tree is very similar to three other *Myrtaceae* present on the island, i. e., *Myrciaria ONeillii,* a common understory tree and associate of *Calycolpus,* and *Myrcia tomentosa* and *Psidium Sartorianum,* low trees most common near the coast. The outer layer of the bark in all four of the species loosens every year or so and is then shed in large sheets and strips. The bark of the trunk and branches of these species, being renewed frequently, supports practically no moss, fungus, or lichens, and is always clean and unusually smooth. The smooth brown trunks and branches, noticeable even to the casual observer, distinguish these trees from all others on the island. During the surveys on the island, the Engineers always used selected branches of *Calycolpus* and *Myrciaria* for stakes when available and always referred to these trees, incorrectly, as "Cocobola."

The firm, glossy opposite leaves are lanceolate, 6–9 cm. long and 2–3 cm. broad. They have a slenderly acuminate apex, and a petiole 2–3 mm. long. The oil cells present in the leaf tissue of all *Myrtaceae* are hardly visible externally in this species. The flowers, 3–4 cm. broad, are borne on pedicels 1–2 cm. long, singly or in pairs, in leaf axils at the tip of the twigs. The petals are pure white on the upper surface, but are decidedly pink or rose on the lower face. The globose flower buds are pink. Flowers were observed during all months from early October to early May but never in great numbers. Except for perhaps a period in February and March there were never more than occasional widely scattered trees in flower at one time. The fruit is green, depressed globose, 10–14 mm. in diameter, and not juicy. It is full of seeds and is crowned by five persistent ligulate sepals 8–9 mm. long and 3 mm. broad. At no time during my visits on the island did I find it present in any abundance. The species is known only from Panama. (Fl. C. Z. p. 287). *Johnston 50, 306, 479, 504, 610; Erlanson 60, 287; Harlow 91.*

Eugenia antiquae Riley

A shrub or small tree, 2–10 m. tall, which appears to be most common and best developed on moderately thin soil on wooded sea cliffs and slopes near the sea. It was found in greatest abundance on Punta del Cabo, where some especially fine examples of the tree grow on the steep wooded rocky slope rising from the beach at the northeastern side of that headland. Elsewhere near the coast it was seen on the cliffs west of Main Beach, on the islet off E. M. Beach, on the cliffs near the Garbage Dump, on the ridge at the mouth of the Rio Marino, and at the mouth of the canyon east of Area 8D. It was found inland only on the northern half of the island, where scattered individuals were seen in open North Forest, in southern parts of Area 8A, and near the junction of the Loop and Met Road, as well as at the fringe of the forest surrounding the grassland on Bald Hill. The largest individuals noted had short trunks up to 15 cm. in diameter. The bark on the trunk and branches is pallid, grayish, dull, minutely ridged and striate, and does not exfoliate.

The opposite, smooth, glabrous leaves, usually broadest above the middle, measure 5–15 cm. long and 3–9 cm. broad, and seem rather variable in the relation of width to length. They are green and somewhat lustrous above, and dull, paler, and usually evidently dotted by protruding oil cells beneath. The apex is obtuse to acute and usually somewhat acuminate. The base is obtuse to acute. The petiole is 8–14 mm. long. The foliage is renewed in late February and March. The plant begins flowering about mid-April, when completely clad in fully grown, fresh, light green new foliage. The small white flowers are borne in small cymes produced in many leaf axils, and for a time are conspicuous. The fruit is subglobose and about 1 cm. long. As it approaches maturity it becomes yellowish, with red cheeks, and is suggestive of a diminutive apple, but subsequently it turns black and becomes very juicy when fully mature in May and June.

The species is with certainty known only from Panama. It is, however, very closely related to and perhaps not actually separable from plants growing in southeastern Mexico, British Honduras, and Honduras. (Fl. C. Z. p. 287). *Johnston 727, 734, 735, 736, 748, 803; Erlanson 105, 291.*

Eugenia origanoides Berg

A shrub or small tree, 2–12 m. tall, growing about forest margins, in open forests, and even as an understory tree in rather dense forests. It is found in all parts of the island but seems to be most abundant on the southern half, particularly near the coast. Distinctive of the species is the abundance of short, soft, brownish hairs that give a thin velvety covering to twigs and to the young leaves, at least, and impart a characteristic tawny or brownish cast to the dark green of the foliage. The trunk becomes 3–15 cm. thick. The wood is hard and dense. The firm, tight bark is gray or somewhat tan, usually has shallow longitudinal furrows and cross checks, and, particularly in age, tends to flake off in rectangular plates 1–3 cm. long.

The firm opposite leaves are broadest at or above the middle, lanceolate to elliptic, 4–12 cm. long and 2–5 cm. broad. Their base is acute to rounded and their apex acute to obtuse and frequently somewhat bluntly acuminate. The upper leaf surface is a dull dark green and even in age has some persisting brownish hairs, especially along the midrib. The lower surface is

paler, somewhat tawny, hairy, and usually minutely roughened by protruding oil cells. The crushed foliage is more aromatic than in other island *Myrtaceae*. The petiole is 2–4 mm. long and always velvety with short brown hairs.

The small fragrant white or cream-colored flowers are borne in dense clusters in the leaf axils. The corolla and stamens turn brown and adhere to the flower for a long period after anthesis is past. Indeed, plants past flowering frequently attract attention because of the conspicuous rust-colored masses of dried floral parts persisting along their stems. The fruit is globose, 4–6 mm. in diameter, and at maturity has a juicy flesh. When submature it becomes red, but finally changes to purplish black when fully ripe. It contains 1–2 seeds. Occasional plants were found in flower or fruit during all months from the first of October to the first of May. The period of general flowering and fruiting, however, probably comes at the close of the dry season.

The species is known from eastern Mexico, British Honduras, and Panama. The plant of Panama, described as *E. Banghamii* Standl., is not distinguishable from that of Mexico and northern Central America. *Johnston 137, 249, 387, 489, 602, 741, 761, 779; Erlanson 66, 118, 515, 518.*

Myrcia tomentosa (Aubl.) DC.

A shrub or small tree, 3–15 m. tall, present in limited numbers along the rocky coast of the southern half of San Jose. Its favored habitats appear to be woods along the crest of sea cliffs and patches of deciduous woodland on areas of thin soil close to the sea. It was seen near OrangeTree Beach, at Long Beach, on Punta del Cabo, at the Garbage Dump, at Navy Cove, north and south of South Beach, at Mango Beach, and on the ridge at the mouth of the Rio Marino. The only place on the southern half of the island where it was seen more than a stone's throw from the sea was on a bit of thin soil (over a half-mile inland) lying along the boundary between Areas 3 and 4 half way between South Road and Mango Beach. On the northern part of the island it was detected only at Bald Hill, where it is rare in the fringe of the forest bordering the grassland. The trunk becomes 5–30 cm. thick and has a light brown tight, smooth, exfoliating bark similar to that of *Calycolpus*, previously described.

The plant is deciduous. Early in the year it forms plump, hairy, ovoid, vegetative buds up to 6 mm. long. All leaves are shed in late February or March. By mid-April the plant is covered with new leafy shoots 2–20 cm. long, bearing fresh, light green, partially sized-up leaves, and fully developed inflorescences coming into flower. The new twigs at flowering time are densely and softly hairy but later become glabrate. The opposite leaves are obovate to elliptic and broadest at or above the middle. They are obtuse to acute at the apex and acute at the base. The margin is usually loosely revolute and the upper surface decidedly convex, particularly so when young. At the time of flowering the foliage is usually 3–6 cm. long, 2–3 cm. broad, pale green, and softly hairy. When fully mature, however, the leaves become 5–12 cm. long and 2.5–7 cm. broad, and are stiff, dark green and lustrous above and practically glabrous. The petioles are 1–2 mm. long and at first soft hairy, later becoming glabrescent.

The small white flowers are produced in slender, elongate, open panicles 3–12 cm. long, which commonly equal or even surpass the subtending leaf in length. The peduncle (2–4 cm. long) and the axis of the inflorescence are

distinctly flattened and hairy. The only fruits seen were some collected by Erlanson at Bald Hill on June 13. These were yellowish, depressed globose, and 5–9 mm. in diameter. They had a thin flesh surrounding an irregular bony stone containing varying numbers of small thick-walled cavities. Most of these cavities were empty, but a few contained what appeared to be aborted ovules. In one fruit, however, a single perfect seed was matured on one side of the bony vescicular mass. This had an elongate hypocotle characteristic of the genus *Myrcia*. Though the fruits collected by Erlanson appear to be abnormal, they are not unusual in this species and its close relatives. DeCandolle, Prodr. **3:** 253 (1828), long ago reported them in three Brazilian species, and I have also observed them in collections from Trinidad. Two fruiting collections from Venezuela, however, do not have these seemingly abnormal fruits. In these latter the fruit is globose, 2–5 mm. in diameter, and has thin fruit-walls enclosing 1–2 seeds similar in size and structure to that matured on Erlanson's collection from Bald Hill.

The species is known from only two stations in Panama, El Valle, Cocle, and San Jose Island. The plants from Panama are certainly conspecific with plants of Trinidad and northern Venezuela and also seem to be the same as the one from French Guiana described and illustrated as *Eugenia tomentosa* Aubl. (1775). Some plants of eastern Brazil, those related to *M. prunifolia* DC. (1828), may also be conspecific. The Panamanian plant, however, has been recently described as *Eugenia vallis* Standl. (1940). Another name for the species is *Aulomyrcia caracasana* Berg (1855), based upon collections from Venezuela. The name *Myrcia caracasana* Kl. ex Berg (1855), however, which some authors have incorrectly treated as a synonym of *Aulomyrcia caracasana*, properly applies to a very different species. *Johnston 747, 801, 1070, 1300, 1307, 1335; Erlanson 284.*

Myrciaria ONeillii (Lundell), comb. nov.

A common and widely distributed shrub or small tree in the forests of the island. It is usually a bush or slender tree 2–8 m. tall, and a common element in the understory of more or less shady forests. Occasionally, however, it may attain as much as 15 m. in height and reach even into the forest canopy. Its trunk, 3–25 cm. thick, is covered with a tight, smooth, light brown, exfoliating bark that is practically indistinguishable from that of its common associate *Calycolpus*. Indeed, so similar is the bark and wood of these two understory trees that non-botanists make no distinction between them. The incorrect name "Cocobola" is applied indiscriminately to both.

The slender leafy twigs are reddish and minutely puberulent. The small opposite leaves, 3–7 cm. long and 1–2.5 cm. broad, are lanceolate and usually slenderly acuminate at the apex and obtuse or acute at the base. They are dark green above and on the lower surface are slightly paler and usually minutely roughened by protrudent oil cells. The petioles (2–5 mm. long) and the midrib are usually puberulent, but otherwise the leaves are glabrous.

The inflorescence is a dense axillary glomerule of 2–12 small flowers. They are produced in large numbers along the leafy twigs. The flowers are borne sessile between a pair of small bracts terminating a peduncle (actually a branch of the suppressed cyme) 1 mm. or less in length. The flower buds have the corolla hidden by overlapping, minutely ciliate sepals, and are reddish, globose, nearly glabrous, warted by protrudent oil cells, and 2 mm.

thick at maturity. The corolla is white and about 5 mm. in diameter and is borne at the summit of a deeply cupulate calyx tube.

The fruit, resembling a red currant, is globose, juicy, insipid, usually 8 mm. in diameter, and brownish or cherry-red when fully ripe. It commonly matures 1–2 seeds. When submature its surface is roughened by many protrudent oil cells.

Occasional plants were observed in flower or fruit during all months from early October to early May. Though nothing suggestive of a general flowering period was observed, there were some indications that flowering and fruiting might be at its maximum from March through June. Reproduction may continue even well into the rainy season, since Harlow collected a flowering plant on August 18, 1945.

The species is known from southern Mexico (Chiapas), British Honduras, Salvador, western Costa Rica, and Panama (Cocle). Until recently, when collections from British Honduras were described as *Eugenia ONeillii* Lundell (1937) the species seems to have been usually misidentified with *Eugenia Capuli* (C. & S.) Berg and *E. Pittieri* Standl. Actually, however, the species seems to be most closely related to *Myrciaria floribunda* Berg (*Eugenia floribunda* West) of the West Indies, from which it appears to differ chiefly in having reddish twigs and firmer leaves. The group of species to which it belongs has its center in eastern Brazil. No representatives of this group are reported from Venezuela, Colombia or Ecuador. Distinctive of the genus *Myrciaria,* heretofore not reported from Central America, is the deep cupulate calyx tube which is circumscissile at the very base after anthesis. Detaching from the ovary it falls from the plant with the withered stamens, petals and sepals still attached. The inferior ovary, furthermore, enlarges very tardily and is very short, obscure, and ill-defined for some time after anthesis. The young, as well as the mature fruit is crowned by a very small, inconspicuous ring of tissue and not by the more or less accrescent, persisting sepals present on the young ovaries and maturing fruit in many species of *Eugenia. Johnston 222, 238, 310, 435, 500, 523, 578, 603, 617, 715, 749; Erlanson 271, 327; Harlow 14.*

Psidium guineense Sw. WILD GUAVA

A loosely branched bush or small tree, 1.5–6 m. tall, occasional at the fringe of the forest surrounding the grassland at Bald Hill and in the thickety growth on the area of thin soil at East Harbor. A few plants also grow on the cliffs back of the beach just north of South Beach.

The opposite leaves are stiff and firm, elliptic or oblong, 8–15 cm. long and 3.5–7 cm. broad. The upper surface is glabrescent. The lower surface has prominent midrib, veins, and veinlets, and is usually soft velvety, especially when young. The foliage is renewed during January. The flowers are white, 3–3.5 cm. broad, and borne 1–3 in leaf axils. The globose fruit, 2.5–3 cm. in diameter, is yellowish and consists of an aromatic, gritty flesh and many seeds. It is edible and has the odor and tart flavor suggestive of strawberries. Flowering starts about April and seems to continue for some months. Fruit is matured during the rainy season and continues present on the trees until January. The species is widely distributed in tropical America. (Fl. C. Z. p. 286, sub *P. molle*). *Johnston 16, 289, 744; Erlanson 290, 295; Harlow 65.*

Psidium Sartorianum (Berg) Niedenzu

A small, loosely branched tree, 3–6 m. tall, locally common on a few sheltered areas of thin soil near the coast, namely, on seaward slopes near OrangeTree Beach, on slopes near Mango Beach, and on the rocky ridge at the mouth of the Rio Marino. Like most of its associates it is deciduous, shedding its foliage about March and remaining leafless during the closing months of the dry season. The trunk becomes 1–2 dm. thick and is covered with a tight, smooth, dark brown exfoliating bark. At OrangeTree Beach and the mouth of the Marino the tree grows with *Myrcia*. When compared the barks of these two species were very similar, the chief difference being the darker color of the present species.

The small opposite leaves, 3–6 cm. long and 1.5–2.5 cm. broad, have an obtuse base and an acuminate apex. They are rather thin and have non-lustrous surfaces which are minutely but abundantly roughened by translucent protruding oil cells. The flowers probably appear early in the wet season. The fruit is globose, yellow, 15–20 mm. in diameter, and contains many seeds. It has a tart flavor suggestive of strawberries and is probably matured in greatest numbers about September or October. Limited numbers were still present on the trees as late as mid-November. The species is confined to Mexico and Central America. *Johnston 486.*

MELASTOMACEAE

(Identifications by H. A. Gleason)

Acisanthera quadrata Pers.

A small, slightly succulent, apparently annual herb with minute glandular pubescence, which was found only on thin soil back of the sea cliffs at East Harbor. The plants were not common. They bore mature fruit and some flowers and were beginning to dry up when collected late in December. The small opposite, ovate to elliptic 3-ribbed leaves, 6–11 mm. long and 3–6 mm. broad, have a toothed margin. The small pink flowers are borne along the stem in the leaf axils. The fruit is a globose capsule. The species is widely distributed in the American tropics. (Fl. C. Z. p. 289). *Johnston 823.*

Clidemia neglecta Don

Known from the island only by collections made on the northeast coast by Andersson in April 1852. It is a densely hairy bush with many of its hairs gland-tipped. The opposite, ovate to lance-ovate leaves, becoming 9 cm. long and 4.5 cm. broad, have five strong ribs. The small white or greenish flowers are borne in small branched terminal inflorescences. The fruit is a berry, usually black. Andersson's collection has old inflorescences with nearly mature fruit and young inflorescences in full flower. The species is widely distributed in tropical America. (Fl. C. Z. p. 293). *Andersson.*

Clidemia rubra (Aubl.) Mart.

A bush 1–2 m. tall with few sparingly branched, reddish brown stems. It is occasional at the edge of the forest margining the grassland on Bald Hill. The stems, twigs and petioles are densely clothed with slender, loosely appressed hairs. This persistent hairy coat is at first gray, but becomes dark in age and gives the characteristic brown coat to the older branches of the species.

The opposite leaves are more or less velvety, 8–12 cm. long and 3–5.5 cm. broad. They have three strong middle ribs which are united for 3–9 mm. above the base of the blade and the points of departure of the simple or double marginal ribs. The pink or reddish flowers, appearing during the wet season, are borne in dense sessile clusters in the axils of the leaves or along the leafless portion of the stem. The fruit is a purple berry becoming 4 mm. in diameter, and is shaggy with purplish hairs even when immature. The species is widely distributed in tropical America. (Fl. C. Z. p. 293). *Johnston 34; Erlanson 282, 428.*

Conostegia speciosa Naud.

A stiff shrub 1.5–3 m. tall growing in thickets. It was observed in very limited numbers along Canyon Road, on the Loop near the start of Canyon Road, and on Bald Hill. The twigs are clothed in a more or less rusty tomentum. The thickish leaves are opposite, 10–15 cm. long, 5–10 cm. broad, and obscurely and finely toothed on the margin. They have the three strong middle ribs united for 3–25 mm. above the base of the blade and the point of departure of the pair of marginal ribs. Their upper surface is densely velvety and tawny. The lower surface is pale and tomentose with minute stellate hairs, and in young foliage is even silky-lustrous. The pink flowers, about 13 mm. broad, are borne in a stiff terminal inflorescence and appear during the rainy season. One of the very distinctive characters of the plant is the conspicuous, very bluish or purplish tomentum that clothes the flower buds, fruits, and old inflorescences. The species is known from Costa Rica, Panama, Colombia, and Venezuela. (Fl. C. Z. p. 290). *Johnston 446, 1166; Erlanson 567; Harlow 69.*

Henriettea succosa (Aubl.) DC.

A shrub or bushy tree, 3–5 m. tall, occasional in very open forests or along forest margins. The species is widely distributed on the island but is uncommon and is usually found as an isolated individual. Its twigs and petioles have a usually rust-colored coating of stout, closely appressed hairs. The opposite rather firm elliptic leaves, 10–20 cm. long and 5–11 cm. broad, bear fewer but similar coarse hairs. Their three strong middle ribs are united for 5–15 mm. above the base of the blade and the point of departure of the pair of marginal ribs. The coarse flowers, appearing during the last half of the dry season, are borne in small umbellate clusters at the base of the leaves and along older portions of the twigs. The calyx and hypanthium are densely and coarsely strigose. The corolla has acute pink petals and is 2–2.5 cm. broad. The stamens are pinkish violet.

The species ranges in Central America and northern South America. The Central American plants perhaps differ from true *H. succosa* of Venezuela, Trinidad, the Guianas, and Brazil, at least in the shape of the flower buds, and may be separable as *H. macrocalyx* (Standl.) Gleason. (Fl. C. Z. p. 293). *Johnston 740; Erlanson 340, 502.*

Heterotrichum octonum (Bonpl.) DC.

A shrub with slender, loosely branched stems, bristly twigs, and light green, usually heart-shaped leaves. Found in undisturbed situations at a few places along the West Loop and along Canyon Road, where it formed bushes 2–4 m.

tall growing in relatively open thicket. It gives one the impression of being a rapidly growing, short-lived plant. During the first two visits to San Jose the plant was listed as rare. However, during the second rainy season following the advent of the Army on San Jose, it increased conspicuously in abundance and became rather generally distributed on the island. In January 1946 young flowering and fruiting plants about 1 m. tall were observed here and there in disturbed soils at roadsides in all parts of the island.

The opposite leaves are ovate or lance-ovate, 9–20 cm. long and 5–13 cm. broad, and have an acuminate apex and a more or less distinctly cordate base. They are 5–7-ribbed and sparingly bristly. On the margin they are ciliate and obscurely toothed. The petioles are 1–7 cm. long, and like the twigs are very bristly and bear some gland-tipped hairs. The flowers are 15–17 mm. broad, have 8 white petals, and are borne in loose terminal inflorescences. The fruit is a globose, very juicy bluish or purple berry, 10–15 mm. in diameter. The species is found in Cuba, Central America, and northern South America. (Fl. C. Z. p. 292). *Johnston 75, 1027, 1349; Erlanson 262.*

Leandra mexicana (Naud.) Cogn.

A loosely branched shrub 2–3 m. tall, growing on banks of ravines in shady forest. Less than a dozen widely scattered plants were found, all in the upper Marino Basin, and most of them in the vicinity of Little Butch Trail.

The slender twigs are velvety and commonly brownish and bear numerous gland-tipped hairs. The opposite ovate leaves, 10–18 cm. long and 6–12 cm. broad, are acute or short-acuminate at the apex and rounded and somewhat cordate at the base. They usually have seven ribs, with the three middle ones united for 1–5 mm. at their base. The petioles are usually slender, elongate, and 2–10 cm. long. The inconspicuous flowers appear during the wet season and are borne in a loose terminal inflorescence. The fruit is a globose berry up to 8 cm. in diameter, which first becomes red but finally changes to purple-black at maturity. The species ranges from Mexico through Central America to Colombia. (Fl. C. Z. p. 290). *Johnston 461.*

Miconia albicans (Sw.) Triana

A bush, 1–2.5 m. tall, not uncommon at the fringe of the forest surrounding the grassland on Bald Hill. It was not seen elsewhere on the island unless some vigorous young bushes discovered in January 1946 in second growth at the side of South Road along the boundary of Area 2A may possibly be referable to the species.

Very distinctive of this plant is the coloration of the felty coating on its twigs. On young shoots this is conspicuously orange or rusty in color. It blanches in age, however, and persisting, may become gray or nearly white on old twigs. The firm opposite leaves, 7–12 cm. long and 3–5 cm. broad, are elliptic or oblong, green and lustrous above, and below clothed with matted hairs and gray or rusty in color. They have three strong ribs. The petiole is 1–2 cm. long. The flowers are borne in a terminal inflorescence and first appear at the close of the dry season. The species is widely distributed in tropical America. (Fl. C. Z. p. 291). *Erlanson 230, 283.*

Miconia argentea (Sw.) DC.

A bushy tree in thickets, 3–5 m. tall, or a tree in and about forests, 6–15 m. tall with a trunk 1–3 dm. thick. It is rather common in all parts of the island

and is a plant that attracts attention by reason of its distinctive contrastingly colored herbage. Because of the pale under surface of its foliage the plant stands out against the prevailingly dark green of surrounding vegetation, and particularly so when its leaves are disturbed by a stiff breeze. The bark, resembling that of *Cordia bicolor*, is gray, corky, and composed of thin papery layers. The opposite elliptic leaves, 10–30 cm. long and 5–15 cm. broad, are dark green and glabrous above and densely and finely pubescent and white or gray beneath. They have five strong ribs. The petiole is 2–5 cm. long. The small white flowers are borne in a much branched terminal cluster and appear about the middle of the dry season. The species is found from southern Mexico to Panama. (Fl. C. Z. p. 291). *Johnston 536, 637, 766; Erlanson 28, 175, 218.*

Miconia hondurensis Donn. Sm.

Only a single plant of this species was found, this close to Canyon Road, about a quarter-mile from the Loop. It was a small tree, about 3 m. tall, growing close to the stream in a shady streamside forest. The opposite leaves, 13–18 cm. long and 5.5–7 cm. broad, are very smooth, nearly glabrous, dark green above, and paler beneath. They are 5-ribbed and acute at both ends. The small white flowers are borne in a small terminal inflorescence and appear in mid-February. The species is known from Honduras, British Honduras, Costa Rica, and Panama. *Johnston 1361.*

Miconia hyperprasina Naud.

A large shrub or small bushy tree, 2.5–6 m. tall, occasional in thickets. The twigs are clothed with minute brownish stellate hairs. The opposite, practically glabrous elliptic leaves, 12–22 cm. long and 5–10 cm. broad, are 5-ribbed, acute at the base and acuminate at the apex. The petioles are 5–15 cm. long. The small flowers have minute white petals and conspicuous yellow stamens and are borne in large numbers in a loose terminal pyramidal inflorescence, chiefly during the latter half of the dry season. The species ranges in Mexico and Central America. *Johnston 668, 762, 1133; Erlanson 88, 96, 138, 229, 266.*

Miconia ibaguensis (Bonpl.) Triana

A species known on San Jose only from fruiting specimens collected by Erlanson on June 13, 1945, in thickets bordering Bald Hill. It is reported to be a shrub slightly over 2 m. tall. The lanceolate opposite leaves, 13–18 cm. long and 4–7 cm. broad, have an acuminate apex and a rounded or obtuse base that is frequently somewhat decurrent on the petiole. The three middle ribs are united for 3–6 mm. above the point of departure of the marginal ribs. The upper surface of the leaves is green and nearly glabrous. The pale lower surface, however, bears short brownish hairs, especially abundant along the ribs. The species is known from Cuba, Mexico, Central America, and South America. (Fl. C. Z. p. 291). *Erlanson 281.*

Miconia impetiolaris (Sw.) Don

A large shrub or small bushy tree 3–6 m. tall which is occasional in thickets. It is readily distinguishable from all other plants on the island by its large, opposite, sessile, amplexicaul leaves. The leaves, 20–35 cm. long and 10–15 cm. wide, are green above, dark brown beneath, and broadest at or above

the middle, with the broad sessile base broadly eared and clasping the stem. Their three strong middle ribs are united for 5–10 cm. above the point of divergence of the marginal ribs. The small white flowers are borne in an elongate terminal inflorescence 1–2 dm. long. The brownish inflorescences develop slowly over several months, generally coming into flower during May. They are, however, a conspicuous feature on the plant as early as February, and from a distance frequently seem to be covered with violet flowers because of the abundance of a small mealy-bug of this color that infests them. The species ranges from Mexico and the West Indies south to Bolivia. (Fl. C. Z. p. 291). *Johnston 690; Erlanson 72, 239.*

Miconia (Sect. Eumiconia) **insularis** Gleason, sp. nov.

M. hyperprasinae Naud. habitu foliis et inflorescentia valde similis, differt calycis limbo truncato lobis obsoletis dentibus exterioribus minutissimis; staminum majorum connectivo valde producto in lobum unicum dorsalem triangularem lateribus circum filamentum deflexis.

Shrub 3–4 m. tall, the younger branches strongly angled, minutely and sparsely stellate-canescent, becoming glabrous in age. Petioles 1–2 cm. long. Leaf blade thin, dark green, elliptic or oblong, up to 16 cm. long and 7 cm. wide, distinctly acuminate to a blunt point, entire or the larger ones sinuate, acute at the base, glabrous and copiously puncticulate above, glabrous beneath, 3-nerved with an additional marginal pair; secondary veins 5–8 mm. apart, diverging at an angle of about 80°. Inflorescence paniculate, 8–13 cm. long and usually somewhat wider, with two lateral branches from the base and three or four at most nodes. Flowers 5-merous, sessile or on pedicels 1 mm. long or less. Hypanthium cup-shaped, 1.3 mm. long to the torus, sparsely and minutely stellate. Calyx tube prolonged 0.4 mm., erect, truncate, the lobes obsolete; exterior teeth triangular, scarcely projecting. Petals white, oblong, 3–3.5 mm. long, a third to a half as wide, slightly inaequilateral. Filaments slender, glabrous, Thecae of exterior stamens 2.4 mm. long, the connective prolonged into a large (about 1 mm. long), triangular, acute dorsal lobe with its sides deflexed. Thecae of the interior stamens 1.9 mm. long, the connective prolonged 0.5 mm. into three similar lobes, one dorsal and two lateral. Ovary one-third inferior, 4-celled; style slender, glabrous, 5 mm. long.

TYPE: *Johnston 448,* San Jose Island, shrub 3 m. tall growing in thicket along Canyon Road, November 10, 1944. (N. Y. Bot. Gard.).

A large bushy shrub growing in thickets. It has been collected at three widely scattered stations on the island, in Area 11B, along Canyon Road, and along South Road. In general habit and foliage it is very similar to *M. hyperprasina*, but in its small flowers and flower buds and slender short pedicels it most suggests, among island species, *M. minutiflora.* The species has been collected in flower at the end of June, in August, and early in November, hence only during the rainy season. I noted it as having a strong, rather offensive odor. Erlanson reports the flowers as "fragrant." The species is known only from San Jose Island. *Johnson 448; Erlanson 403, 573.*

Miconia lacera Naud.

A loosely branched shrubby plant, 1–3 m. tall, bearing coarse tawny or reddish bristles 4–14 mm. long in conspicuous abundance along its slender stems. Before the advent of the Army the plant was apparently uncommon

on the island. In 1944 I observed it only at the fringe of the forest surrounding the grassland on Bald Hill and in a sheltered open place on a wooded cliff near Main Beach. Erlanson collected it in July 1945 near the Navy Station. During the rainy season of 1945 the plant appeared and got well established in second growth. In January 1946 I noted many plants, usually about 1 m. tall and generally in fruit, at scattered places along roads in various parts of the island.

The opposite lanceolate leaves, 8–20 cm. long and 2.5–7 cm. broad, are hairy, green above and paler beneath. They have five strong ribs, an acuminate apex, and a rounded or obtuse base. The shaggy petioles are 1–4 mm. long. The small, inconspicuous pinkish flowers are borne in a terminal inflorescence and appear early in the wet season. The black or purplish black globose, very juicy berries are matured in the wet season and in the early months of the dry season. The species is widely distributed in the American tropics. (Fl. C. Z. p. 291). *Johnston 35, 61, 1110; Erlanson 496.*

Miconia minutiflora (Bonpl.) DC.

A bush or small tree 2–7 m. tall which is frequent in the fringe of the forest margining the grassland on Bald Hill and is occasional in thickets in other parts of the island. The lanceolate leaves, 6–12 cm. long and 2–4 cm. broad, are practically glabrous, green above and paler beneath. They have three strong middle ribs and weak marginal ones. The petioles are 5–10 mm. long. The small white flowers, with very slender pedicels 1–5 mm. long, are borne in a loose terminal, pyramidal inflorescence. The flowering probably begins in the middle of the rainy season and can continue into February. The fruit, small, subglobose, dry, and about 3 mm. in diameter, is produced in great abundance and apparently matures very slowly. I observed it as early as the first of October and as late as the end of February. Observations on one tree, continued for several weeks, suggest that the species may be partially cleistogamous. When first discovered there were numerous well-developed inflorescences and what appeared to be completely mature flower buds. Though only a very small fraction of the buds ever opened, the inflorescences all eventually set fruit abundantly. The plant has a characteristic response to direct sunlight. The stems, inflorescences, and fruit, green on the inner parts and on the sheltered sides of the bush, become purple where exposed to the direct sunlight, commonly so conspicuously as to attract attention. The species ranges in Panama and northern South America. (Fl. C. Z. p. 291). *Johnston 32, 1097, 1210, 1394.*

Miconia pteropoda Benth.

A shrub, usually 3–4.5 m. tall, occasional in thickets. It may develop a trunk 15 cm. thick. Among the island melastomes it is readily distinguished by its conspicuously winged petioles. The opposite elliptic leaves, 13–26 cm. long and 6–10 cm. broad, are practically glabrous. Their three strong medial ribs are united for 9–12 mm. above the point of departure of the marginal ribs. The apex is acuminate while the base is acute and decurrent along the petiole to form distinct marginal wings 1–5 mm. broad. The small white flowers are produced abundantly in large pyramidal terminal inflorescences, most commonly during April and May. The branches of the inflorescence are frequently pink or purplish. The species ranges in Central America and in

Amazonian South America. (Fl. C. Z. p. 291). *Johnston 760, 770, 1111; Erlanson 89, 265.*

Pterolepis pumila (Bonpl.) Cogn.

A slender, sparingly branched annual herb 1–6 dm. tall which was found in limited numbers on the grassland at Bald Hill and on the thin soil area back of the sea cliffs at East Harbor. The stems bear several longitudinal lines of coarse appressed hairs. The opposite lanceolate leaves, 2.5–5 cm. long and 10–17 mm. broad, are 3-ribbed and bear slender appressed bristles on both surfaces. The pink flowers are borne in the axils of small upper leaves on the stem and its laterals. The fruit is a small capsule. Plants with flowers and mature fruit were found in December. The species is found in Mexico, Central America and northern South America. *Johnston 824, 889.*

Schaeckaea cupheoides (Benth.) Cogn.

An erect annual herb 1–6 dm. tall growing in thin soil at the top of sea cliffs at East Harbor, near Mango Beach, on Hicaco Island, and near the Engineer Camp. Its stems are usually red and sparingly branched. The opposite ovate to elliptic leaves, 15–50 cm. long and 1–3 cm. broad, are 3-ribbed, green and nearly glabrous on the upper surface, and pale and minutely strigose beneath. The small bluish pink flowers are borne nearly sessile in the upper leaf axils. The fruit is a capsule enclosed at maturity in an enlarged elongate calyx that has ten thickened corky ribs. The plant comes into flower in October and has matured its fruit and is ready to dry up by the end of December. Ranging in Central America and northern Colombia. (Fl. C. Z. p. 290). *Johnston 176, 219, 936A.*

ONAGRACEAE

JUSSIAEA ERECTA L.

This annual plant was first found on the island by Erlanson, who collected some large individuals, 18 dm. tall, on the bluffs at East Harbor. It is a slender, glabrous herb with small yellow flowers which grows rapidly at the close of the wet season, flowers and fruits abundantly at the beginning of the dry season, and dies about February. I did not find the plant near East Harbor during October and November 1944. In late December 1945 I could find none of it in undisturbed places near East Harbor, though in the general vicinity, especially near the Rock Crusher and along East Road near the Air Strip, it was very abundant on disturbed soil in places where storm water formerly collected. On the first of January a few plants were also found in the new lawns at Camp, where it associated with introduced weeds. While there remains a possibility that the species may be native, and, like some other plants, has spread inland from areas of thin soil and coastal cliffs to which it was formerly restricted, its general behavior on the island is that of a weed recently introduced from the Isthmus. The species is widely distributed in tropical America. (Fl. C. Z. p. 294). *Johnston 834, 1003, 1107; Erlanson 579.*

JUSSIAEA SUFFRUTICOSA L.

In January 1946 two plants of this species were found growing with some other introduced weeds on an abandoned clearing at the forest margin near the Mata Puerco Bridge, and several more were found in company with other

weeds in the lawn at Camp. The plant is obviously a recent introduction from the Isthmus. It is a variable plant widely distributed in tropical America. The form of the species on San Jose belongs to the var. *ligustrifolia* (HBK.) Gris. (Fl. C. Z. p. 294). *Johnston 1003A, 1186.*

ARALIACEAE

Didymopanax Morototoni (Aubl.) Decne. & Pl. PAVA

A large tree with ascending forked branches and a broad, domed, umbrella-like crown. It grows commonly 10–25 m. tall and frequently approaches 30 m. in height. The trunk, 2–8 dm. thick, is covered with a thick, rather smooth, pale bark, and frequently rises 10–20 m. without a branch. The tree is most abundant in forests where it grows scattered, reaches large size, and usually projects its broad, rounded crown well above the main canopy. One gets no idea of the size and dignity of this handsome tree in the forest. It is only from the occasional isolated specimen standing majestically in high thicket or in very open forest that its beauty and presence can be appreciated Its size and role in the forest can be judged only from above. The rounded crowns projecting here and there above the canopy of the forest are features in aerial photographs of the island. Many of the emergent crowns are to be seen as one looks northwestward across the forests of the Marino Basin from Red Hill. Others can be seen looming up above the vegetation on the headland southwest of Camp.

The palmately compound leaves are made up of 9–12 slenderly stalked leaflets which are green above and are golden, somewhat coppery, or rarely tan beneath from a fine coating of appressed silky hairs. These leaflets fluttering in a stiff breeze, exposing alternate green and golden surfaces, give this fine tree one of its distinctive and charming aspects. They are usually 15–30 cm. long, 4–8 cm. broad, broadest above the middle, obtuse at the base and slenderly long-acuminate at the apex. Their petiolules are 3–8 cm. long. The main petiole of the leaf becomes 4–7 dm. long. Though evergreen, the tree thins out its foliage noticeably during the last half of the dry season. During this time the leaflets, readily recognizable by their golden under surface, fall in considerable number, accumulate in places, and become attractive objects on the forest floor.

Seedlings of this species appeared in large numbers in disturbed soil along roads at some places in the forests. None were seen, however, in areas of thicket or in very open forest. The foliage of the seedlings differed noticeably from that of matured trees. Seedlings one year old had only simple leaves. Those two years of age mostly had some persisting simple leaves but were generally developing leaves with 3–7 leaflets. All this juvenile foliage was thin, light fresh green in color, and bore scattered very coarse tawny hairs along the margins and on the upper surface, but were otherwise glabrous.

The flowers and fruits, borne in loose terminal panicles 2–5 dm. long, are present on the trees from November to February. The fruit is small and very strongly compressed, being 6–8 mm. broad, 3–4 mm. high and 1–2 mm. thick. The species ranges in Central America, the West Indies, and northern South America. (Fl. C. Z. p. 295). *Johnston 920, 1172.*

MYRSINACEAE

Ardisia compressa HBK.

A slender, loosely branched shrub, 1.5–4.5 m. tall, growing in forest shade. It is frequent at places in forests of *Tetragastris* on the wooded slopes of Red Hill, in the canyon of the North Fork of the Marino, in Area 8C, and in the eastern portions of Area 7A. Erlanson has a collection of the species from a shaded ravine in Area 11A and another labeled as an epiphyte growing on a tree near South Beach.

The leaves, 6–14 cm. long and 2–5 cm. wide, are broadest at or rarely above the middle and have an acute base and an acuminate apex. They are rather firm, green above, pale beneath, and show scattered, rather obscure translucent dots when viewed in front of a light. The petiole is 3–5 mm. long. The flowers are borne in loose pyramidal panicles 3–5 cm. long and 4–7 cm. broad. The petals, 5–6 mm. long, become recurved and are white or pinkish and marked with characteristic rust-colored dots and streaks. The fruit is spherical, 4–6 mm. broad, and dotted with oil cells. It is first reddish but becomes black and has a thin edible flesh when completely mature. Flowering and fruiting plants can be found, apparently, at almost any time of year. The species ranges in Mexico, Central America, Venezuela, and Trinidad. (Fl. C. Z. p. 298). *Johnston 93, 464, 589; Erlanson 50, 373, 545.*

Rapanea guianensis Aubl.

A tree 5–12 m. tall, noted in very limited numbers at a few places, mostly in woods near the coast. It was seen at Navy Cove, on the hills southwest of Camp, near the road about a quarter-mile southwest of the Goat Barn, at OrangeTree Beach, at the shore end of Canyon Road, and in Area 8D. Several dozen trees were located southwest of Camp, but at the other stations listed only one or a very few individuals were found.

The firm leaves, 6–10 cm. long and 2–4 cm. broad, have a prominent midrib but very inconspicuous lateral veins. They are lustrous, dark green above, paler beneath, and loosely revolute at the margins. Held before a light they show numerous but rather obscure translucent dots. The petiole is 5–8 mm. long. The slender, elongate terminal bud, frequently present on vigorous twigs, is useful in identifying the species in the field. It is subulate, 2–4 cm. long, and about 3 mm. thick towards its base. The small whitish flowers are produced in very dense glomerules in the leaf axils. Only two trees were found in flower, one on November 9 and the other on December 23. No fruit was seen. The species ranges widely in tropical America. (Fl. C. Z. p. 297. sub *R. pellucido-punctata*). *Johnston 441, 849.*

SAPOTACEAE

(Identifications by Arthur Cronquist)

Manilkara Chicle Pittier NISPERO

A handsome forest tree that attains large size. It grows scattered, singly or in small colonies, frequently in soil on or near exposures of bedrock, and is most common within a half-mile of the coast. The finest growths of it are in forests near the ocean, especially those on headlands and on rocky seaward slopes. One of the major islets off the southeastern point of San Jose is, in fact, forested with almost a pure stand of the species. The tree is

decidedly less frequent on the northern half of the island than it is on the southern half. Its characteristic large, dense, dark green crowns are very conspicuous features on the headlands and in the forests topping the sea cliffs along the south coast from Punta del Cabo to Punta Nispero. They are to be seen in conspicuous numbers on the north coast only at the tip of Punta Cruz and on a headland near the end of Canyon Road. Well-developed individuals grow 15–30 m. tall and have a ponderous, nearly cylindrical trunk free of branches for 10–15 m. The thick, commonly somewhat grayish bark is usually longitudinally furrowed and cross-checked. It is, accordingly, broken up into rectangular plates 3–6 cm. long and hence checkered in appearance. When cut the trunk slowly oozes small amounts of a thick gummy white latex. The tree usually looms above and dominates all surrounding vegetation. Individual trees can be studied conveniently at several places on the island. A small specimen grows by the B. O. Q. at Camp and others are present on the terrace beyond the stream mouth at South Beach. A handsome isolated specimen, the most northern of the trees seen on the island, has been left standing in the clearing at the north end of the Loop. Notable also is the grove of fine trees on Navy Road, a few hundred yards from South Road, and the scattered large trees about the road-junction just east of Red Hill.

The leathery leaves, 10–18 cm. long and 3–6 cm. broad, are pointed at both ends and broadest at or above the middle. They are dark green above and beneath are paler green or have a golden glow from an abundance of minute appressed silken hairs. The midrib is conspicuous, but the lateral veins are obscure. The petiole is 1–2 cm. long. The small greenish yellow flowers have pedicels 5–10 mm. long and are borne several together in the leaf axils. They were collected late in April 1945 on the injured tree standing by the B. O. Q. at Camp. The normal season of flowering, however, probably does not occur for a month or two later, probably just after leaf renewal at the close of the dry season.

In late October 1944 the trees were loaded with very immature fruits about 15 mm. in diameter. Many had fallen, apparently because of parrots, and were conspicuous objects on the forest floor beneath the trees. In December 1945 the fruits were well sized up but still immature, having a puckery taste and undarkened seeds. Parrots, however, were breaking them open and devouring the seeds, leaving the ground beneath the trees littered with fruit fragments. The fruit reaches full maturity in February. It is then subglobose, 2.5–3.5 cm. in diameter, and has a tough, rough brown rind surrounding a sweetish, brownish yellow flesh and 2–5 large embedded seeds. By the end of March most of the fruit has fallen. The brown polished biconvex seeds are distinctive. They are 15-18 mm. long, 8–11 mm. broad, and 4–6 mm. thick, and have a narrow elongate attachment scar on the edge towards the end. The pedicel of the fruit is coarse, 1–2 cm. long, and tends to be recurving. The species is found from Mexico to Colombia. (Fl. C. Z. p. 300, sub *Achras calcicola*). *Johnston 336, 342, 646, 751, 753.*

Pouteria campechiana (HBK.) Baehni

Occasionally a small bushy tree up to 7 m. tall, but usually a forest tree becoming 8–20 m. tall and developing a trunk 3–6 dm. thick. It may have a trunk approaching a meter in diameter, but only in very old trees, mere shells, with the heartwood almost completely rotted away. The tree is rare

on the northern half of San Jose but is widely distributed on the southern half of the island, where it is rather common in some forests near the coast. It seems to be particularly abundant and well developed on the headland of Punta del Cabo. Other rather good growths of it were noted in the forest near OrangeTree Beach. A number of very fine individual trees grow near the south end of the Navy Cove Road. The trunk of the older trees is very distinctive. It is irregularly fluted, usually distorted by small burls, and very asymmetric in cross section. The longitudinal ribs of the trunk anastomose here and there. The pronounced rounded grooves between them, as a result, may vary from a meter or more to only a few centimeters in length. Even when short the grooves may be several centimeters in depth. When very deep and short they become the small pocket- or cave-like recesses that are characteristic features of the older trunks of this species. Some of these recesses collect water or as much as a handful of debris. Giving a gnarled appearance to the irregularly fluted trunks are rough-barked swellings of burls of varying size and abundance. Most of these burls are 15 cm. or less in diameter. All of them bear stiff spine-like adventitious roots 1–3 cm. long. They usually form a rough, irregular swollen band about the base of the trunk, a decimeter or more above the soil, and in very old trees may also be present, causing deformations on up the trunk for a meter or more. Many moderately large trees have rotted heartwood and most of the large old ones are completely hollowed out by decay, which probably started originally in some of the moist debris-filled natural recesses in the trunk. Most trees with large hollow trunks, those of great age, tend to produce new trunks by producing sucker shoots from their bases. A number of cases were observed where goodsized trees growing near one another had clearly developed from suckers of an older tree now practically disappeared. The hollow stump of one fallen tree suggested a pollard and was producing an abundance of vigorous sucker shoots. The bark of the tree is gray or brown and finely scaly and in some small trees, those with trunks 1 dm. or less thick, somewhat checkered and flaking off in small, thin papery scales. When cut the bark oozes small amounts of a thick, sticky, milky latex.

The leaves, 8–18 cm. long and 2.5–5 cm. broad, are acute at both ends and usually broadest at the middle. They are light green in color, rather thin in texture, and have obvious veins as well as midribs. The petiole is 8–30 cm. long. The foliage is renewed during January and February. The greenish flowers, borne on pedicels 8–15 mm. long, are produced several together in the leaf axils during March, shortly after leaf renewal. Immature fruit is subglobose, has a scurfy brown surface, and is 10–15 mm. in diameter and rather conspicuous on the trees in April. The fruit matures in late May. It is 2–2.5 cm. thick and nearly as long and is yellowish or orange when fully ripe. The edible flesh, said to be yellow or orange, surrounds one or two large plump ellipsoidal seeds. The species ranges from Mexico to Panama. (Fl. C. Z. p. 301, sub *Lucuma salicifolia*). *Johnston 252, 491, 525, 526, 733, 944, 1171; Erlanson 201, 235, 301, 396.*

Pouteria stipitata Cronq.

A tree 5–20 m. tall. Though widely distributed on the island it is rather uncommon. It grows in rather open forests and appears to favor areas with shallow soils. The tree usually grows widely scattered. However, at a few

places, such as the south end of the East Loop, it can become fairly common locally. As on the East Loop, these congregations tend to occur along the margins of bits of Deciduous Forest developing on areas of thin soil. The trunk has a thin, tight brownish bark and is asymmetric in cross section. It is irregularly ribbed and can be slightly buttressed at the base, but never develops the pronounced fluting, the burls, nor the deep recesses so characteristic of *Pouteria campechiana*. The largest trunk seen, that on a a tree 20 m. tall, measured 3.5–5 dm. thick and rose 9 m. to the first branch. When cut the bark slowly oozes small amounts of a sticky, cream-colored latex.

The lustrous, rather firm leaves, 8–15 cm. long and 2.5–4.5 cm. wide, are broadest above the middle, gradually contracted towards the petiole (1–1.5 cm. long), and usually acuminate at the apex. The small flowers are white and borne on pedicels 2–4 mm. long. They are produced along the twigs, many from each leaf axil. A plant coming into full flower was collected by Erlanson on June 20, 1945. It bears flowers and buds on the partially naked twigs and apparently represents the tree in a stage of leaf renewal, there being present a young terminal shoot with new leaves, and some old leaves still adhering to the old twig that has produced most of the flowers. No fruit nor any remains of it was observed. The species is known only from Panama. *Johnston 634, 1291; Erlanson 324.*

LOGANIACEAE

Spigelia Anthelmia L.

A sparingly branched opposite-leaved herb 1–4 dm. tall, occasional on open areas of thin soil back of the sea cliffs at East Harbor. There it grows in undisturbed places in the company of native species and gives every evidence of being indigenous on the island. However, the few indistinguishable plants found growing as weeds in the lawn at Camp on January 21, 1946, probably sprang from seeds originating on the isthmus. The species is widely distributed in tropical America. (Fl. C. Z. p. 302). *Johnston 186, 1248; Erlanson 453.*

Strychnos panamensis Seemann

A woody vine growing over thickets on the headland south of the entrance to Bodega Bay and over thickets margining the swamp at the mouth of the Rio Marino. The main stems of this vine reach at least 5 cm. in diameter. The plant has distinctive tendrils. These are produced along leafy twigs on the younger parts of the plant, and are unbranched, a few centimeters long, and spring singly from the axils of usually aborted leaves. They function as a grappling device. Their somewhat thickened outer half bends into a coarse hook or scanty flat coil which eventually tightens, thickens, and becomes permanently affixed to any supporting twig over which it may have become hooked.

The opposite leaves, 5–14 cm. long and 2–5 cm. wide, are broadest at or below the middle and have a rounded to acute base and an acuminate apex. They are dark green, almost glabrous, and evidently triple-ribbed. The petiole is 3–5 mm. long. Neither flowers nor fruit were seen on the island. Judged from the behavior of the species on the mainland the flowers probably appear in June or July. Flowers are tubular, 1.5–2 cm. long, white or yel-

lowish, and borne in clusters at the end of the twigs. The globose fruit is 4–8 cm. in diameter. The species is found in Mexico, Central America, Colombia, and Venezuela. (Fl. C. Z. p. 302, plate 60). *Johnston 1299.*

GENTIANACEAE

Coutoubea spicata Aubl.

An herb 3–12 dm. tall, developing a dense elongate spike of flowers. The corolla is white or cream with its outer surfaces more or less flushed with violet or bluish. The plant grows in the grassland on Bald Hill and at many places on islets and cliffs along the coast of the island. Though widely distributed in its particular habitat, it is not common. It apparently comes into flower during the middle of the rainy season and continues in flower through February. The species is widely distributed in tropical America. (Fl. C. Z. p. 304). *Johnston 293, 884, 1302.*

Curtia tenella (Mart.) Cham.

A very slender, delicate, inconspicuous herb growing in the grassland on Bald Hill. It rarely exceeds 15 cm. in height, has a single erect hair-like sparingly branched stem, minute leaves, and white flowers about 5 mm. in diameter. Growing generally scattered, and never common, between loosely spaced grass clumps, it is rarely seen unless searched for, preferably on hands and knees. It seems to be most common on the steeper, better drained slopes in the eastern half of the grassland. Flowering probably begins about the middle of the wet season. Harlow collected flowering plants on September 18, 1945. I was able to find a few plants still flowering as late as December 24, 1945. The plant ranges from Mexico to Brazil and is confined to savannas and similar grassy places. (Fl. C. Z. p. 304). *Johnston 47, 877; Harlow 62.*

Leiphaimos azureus (Karst.) Gilg

A delicate, pale saprophytic herb appearing on shaded forest floors during the closing months of the rainy season. It is lacking in chlorophyll and has slender white leafless stems about 10 cm. tall, which are terminated by a single rather attractive pale blue corolla 8–12 mm. in diameter. Upon examination the flower is seen to possess a very inconspicuous small calyx and a well-developed, conspicuously swollen pale corolla tube. The five spreading blue corolla lobes are broad and rounded.

The plant first appears in September, becomes most abundant during October, and continues in decreasing abundance through November. I found it at many places on the northern half of the island, but it was most common in forests of *Tetragastris,* and especially where there was some accumulation of old leaves. In some places scattered hundreds of the lovely little blue flowers could be found peering up from the damp shaded floor of the forest. The plant can also grow in somewhat disturbed soils. Great numbers of them were encountered along the sides and even down the middle of the relatively new ungraded road leading to the Central Met. Station and even about the door of the station itself. The species is known only from Panama, Colombia, and Venezuela. *Johnston 140; Murphy.*

Leiphaimos stenoloba, sp. nov.

Herba saprophytica aurantiaca 10–15 cm. alta; caulibus pluribus strictis gracilibus sulcatis squamis hyalinis oppositis ornatis cymos laxos 3–7-floris gerentibus; calyce persistenti hyalino 2–3 mm. longe pedicellato, tubo campanulato 2–3 mm. profundo 1.5–2 mm. diametro, lobis 5 lineari-subulatis ad 3 mm. longis supra basim 0.2 mm. latis, sinibus apertis 0.7–1 mm. latis basi rotundatis; corolla aurantiaca in alabastro 15–18 mm. longa, lobis divergentibus 5 lanceolatis 3–4 mm. longis ad 2 mm. latis apice acutis, tubo ca. 12 mm. longo medium versus ca. 1.5 mm. crasso infra medium ventricoso intus in parte mediali villuloso, faucibus intense aurantiacis ceterum vix distinctis; filamentis ad 1 mm. longis ca. 2 mm. infra sinibus corollae affixis; antheris 5 ut videtur vix cohaerentibus ca. 1 mm. longis et subaequilatis medialiter affixis, apice obtusis ca. 0.5 mm. infra sinibus corollae attingentibus, loculis infra medium distinctis imam ad basim brevissime abrupteque apiculatis, apiculis ca. 0.5 mm. longis minute puberulentis; ovario subsessili eglanduloso ad anthesin 5–6 mm. longo valde elongato; stylo filiformi; stigmate capitato apice tubi corollae attingenti; capsula bivalvis elongata 7–8 mm. longa 2–2.5 mm. crassa usque ad basim dehiscenti; seminibus brunneis minutissimis.

TYPE: *Johnston 1116*, San Jose Island, hill north of Cross Roads, one colony in leaf mold on sheltered forested bank.

This interesting little saprophytic herb was seen only twice, once on November 4, 1944, in the northern part of Area 7A near the Loop, and again on January 12, 1946, beyond the stream north of the Cross Roads. It grew in very limited numbers in leaf mold on sheltered, densely forested south-facing slopes and under trees of *Tetragastris* at both stations. Two colonies were found; they occupied only a few square yards of shady forest floor.

The plants are devoid of chlorophyll and are orange in color. They consist of one to several slender, leafless erect stems that lift 3–7 tubular orange flowers about 1 dm. above the leaf mold. The underground stems are white and very juicy. The corolla tube is about 12 mm. long, about 1.5 mm. thick above the middle, and below the middle evidently distended by the developing fruit it encloses. The limb, up to 8 mm. broad, is composed of 5 narrow, sharp-pointed, lanceolate lobes. The colorless membranous calyx has a campanulate tube 2–3 mm. deep and 5 subulate erect lobes about as long.

The species is known only from San Jose Island but is related to *L. trinitensis* (Gris.) Gilg, of Trinidad, and to *L. aurantiaca* (Splitg.) Miq. of the Guianas. It is distinguished from the former by its looser habit of growth and apiculate rather than tailed anther bases, and from the latter by its apiculate rather than obtuse anther bases, broader corolla lobes, and evidently ventricose corolla tube. The San Jose plant has a larger and proportionately more elongate ovary than either of its relatives, and accordingly, also, a more prolonged ventricose distortion of its calyx tube. The orange color of the plant and its campanulate calyx with widely separated filiform-subulate lobes readily distinguish it from all other members of the genus known from Central America. *Johnston 380, 1116.*

Schultesia guianensis (Aubl.) Malme

A small, glabrous, opposite-leaved herb with light pinkish brown corollas growing on thin soil at the head of the sea cliffs at East Harbor. It was collected in flower in October and November, but no remnants of it could

be found in December a year later. The species is widely distributed in tropical America. (Fl. C. Z. p. 304). *Johnston 192.*

Schultesia lisianthoides (Gris.) B. & H.

A small, glabrous, opposite-leaved herb with bluish pink flowers which was collected in thin soil at the top of the cliff at South Beach. The plants bore capsules and a few remaining flowers, but were beginning to dry up when collected on January 9, 1946. The species is known from Central America and northern South America. (Fl. C. Z. p. 304). *Johnston 1095.*

APOCYNACEAE

Forsteronia spicata (Jacq.) Meyer

A scrambling shrub with milky latex, frequent in thickets at scattered localities on the island, mostly within a half-mile of the coast. It was seen in Area 11A, in Area 11D, near the west end of Canyon Road, on Observation Point, at the east end of the trail between Areas 3D and 4A, near the Air Strip, and in Area 8B. The opposite leaves, 5–20 cm. long and 3–7 cm. broad, are green on the upper surface, and beneath are paler and roughened with prominent midrib, veins, and veinlets. The petioles are 3–10 cm. long. The small greenish yellow flowers are crowded into dense clusters in the outermost leaf axils and usually aggregated into a stout interrupted spike terminating the twig. Erlanson collected the flowering plant on May 9 and June 7. Only sterile plants were seen during my visits on the island. The species ranges from Cuba and Mexico south into Colombia. *Johnston 1065, 1099; Erlanson 95, 258.*

Forsteronia viridescens Blake

A strong vine climbing to the canopy in forests and at times growing over thicket near forest margins. It was noted on the trail west of Bald Hill grassland, along the Loop south of Area 11D, along Canyon Road, near Orange-Tree Beach, along the road east of Max Point, on the Navy Cove Road, and at the southeast margin of Area 4A. Erlanson collected it in Area 7A. Since it grows high in forest trees where it is not easily detected, the plant is very likely much more common and generally distributed on the island than the few listed stations would indicate.

The main stems have a central pith but become very woody and can reach at least 7 cm. in diameter. Unlike the leafy shoot, the main stems ooze no latex when cut. The plant seems to have its period of vigorous vegetative growth in January and February. The leafy shoots are smooth, glabrous very lactiferous, and twining when young. The smooth, somewhat coriaceous opposite leaves, 7–15 cm. long and 2.5–5 cm. broad, are lustrous green above and paler and without prominent veins beneath. The petioles are 1–3 mm. long. The small cream-colored flowers are borne in small, tight, stalked glomerules that are aggregated into an open panicle terminating the twigs. They appear during March and April. The fruit, a pair of slender diverging pods 2–2.5 dm. long and 4–5 mm. thick, was collected by Erlanson at the end of June. Previous to its discovery on San Jose the plant was known only from British Honduras. *Johnston 581, 650, 1185; Erlanson 339; Campbell 5.*

Mandevilla subsagittatum (R. & P.) Woodson

A slender twining vine forming netted growth in thickets and in second growth. The plant has found a congenial new habitat in second growth and has obviously greatly increased in abundance since the Army occupied the island. In 1944 it was found at only a few places and was listed as relatively rare. In December 1945 it was to be seen here and there in the new growth along roads in all parts of the island. The very slender stems ooze little or no milky latex when cut. The opposite leaves, 4–8 cm. long and 1.5–4 cm. broad, are green above and distinctly pale beneath. They are pointed at the apex and strongly eared and deeply cordate at the base. The petiole is 5–20 cm. long. The inflorescence springs from the leaf axils, has conspicuous elongate long attenuate bracts and is first umbellate but eventually elongates and may become a raceme 4–8 cm. long. The corolla has a tube 2.5–3 cm. long and a spreading limb 3–4 cm. broad. It is yellow on the lobes and reddish brown in and about the throat. The flowers appear during the rainy season. The species ranges from Mexico to northwestern South America. (Fl. C. Z. p. 309, sub *Echites microcalyx*). *Johnston 52, 346; Erlanson 534, 566.*

Peltastes isthmicus Woodson

A coarse vine of distinctive aspect that climbs up 5–15 m. on the viny curtains of forest margins and up trees in open forests, and rarely over high thickets at the edge of forests. It is widely distributed on the island and is not uncommon.

The stems are rather flexible, never very woody, usually 4–8 mm. thick, and seldom exceed 1 cm. in thickness. They usually grow directly upward, frequently twining about one another, and have very few branches. When young they are clothed with a fine brown tomentum. Their growth is very rapid and it is possible that they may function only one season. Though I was unable to prove it, I still suspect that the plant has large underground storage organs which enable it to send up its stems anew each year. During October and November 1944 only a single plant of the species was observed, this apparently a precocious individual beginning vigorous new growth over the thicket margining the forest back of the mangrove swamp at Playa Grande. During January and late December 1945–46, however, the plant was to be seen in all parts of the island. It was evidently the period of vigorous growth for the species. The coarse brown stems, bearing large opposite elliptic leaves and growing rapidly up towards the treetops, were a frequent sight along many roads. In many places, because of the freshness of their large leaves, they contrasted and stood out against the darker green of the supporting vegetation and even attracted attention. By mid-February the stems had reached the treetop and the period of rapid growth seemed past. Among the notes accompanying a flowering specimen of the plant collected by Erlanson on May 14 is the statement that the vine had a milky latex. There is some evidence for believing that certain Apocynaceous plants develop latex only at special seasons, as in this instance only at maturity. In any case, I observed this species during most months from early October until the last of April, and never found it producing latex. When cut, the stems all oozed a thick, syrupy, honey-like exudation.

The leaves are very distinctive and unique among island plants in the attachment of their petioles. The leaves are opposite, elliptic to orbicular-

elliptic, 1–3 dm. long and 0.7–2.5 dm. broad, and are borne on petioles 2–12 cm. long that are attached, not to the margin of the blade, but to its back, 0.5–7 cm. in from its lower edge. They are slightly fleshy and their upper surface is green, while their lower surface is pale and somewhat tawny.

Numerous seedlings up to a meter tall were found in January 1946 at roadsides. They grew erect and unbranched and had well-developed spreading fibrous roots. There was no strong development of the taproot nor any indication that storage organs might be developed underground. The first four to eight pairs of leaves produced by these young plants differed from mature leaves in shape and attachment. They were broadly lanceolate, had their petioles attached to the margin of the blade, and were usually 4–8 cm. long. Their petioles were only 8–15 mm. in length. Leaves developed subsequently by the seedlings gradually became larger and proportionately broader, while the petiolar attachment shifted from marginal to more and more clearly dorsal.

The flowers are yellow, funnelform, up to 8 cm. long, and borne in loose clusters at the leaf axils. No evidence of flowering or fruiting, past, present, or coming, was detected during my stay on the island. The species apparently flowers early in the wet season. Erlanson collected a flowering plant along Navy Cove Road on May 14. On the Isthmus most flowering plants seem to have been collected in August and September. The species is known only from Panama and Costa Rica. (Fl. C. Z. p. 309, sub *Echites peltata*). *Johnston 281, 968, 1079; Erlanson 115.*

Prestonia portobellensis (Beurl.) Woodson

A vine with elongate, moderately slender stems found occasionally in thickets, in open forests, and in second growth. None of the plants examined had milky juice, and, according to his notes, it was not present in three of the four collections made by Erlanson. In one of his collections (no. *117*, obtained May 14), however, a milky juice is reported as present.

The thickish opposite leaves, 8–20 cm. long and 2.5–8 cm. broad, are slightly glossy above, dull and rather prominently veined beneath. The flowers are produced in loose umbellate clusters along the stem. They first appear late in the dry season and continue to appear throughout most of the wet months. The corolla, 10–15 mm. long, is yellowish in the throat. The spreading limb is 20–26 mm. broad and has the white and pink lobes marked with violet lines. The fruit is a pair of very slender pods, 2 dm. long and 3–4 mm. thick, filled with flat seeds bearing a grayish coma. The species ranges from Mexico to Panama. (Fl. C. Z. p. 309, sub *Prestonia macrocarpa*). *Johnston 347, 386, 767, 1096, 1278; Erlanson 117, 309, 367, 575.*

Plumeria rubra L.

A shrub with rough, coarse, erect, sparingly and loosely branched stems 2–4 m. tall that bleeds copious amounts of milky latex when cut. It is common and readily studied near the lookout at East Harbor. It is a plant restricted to areas of thin soil along the coast. It is most characteristic of open, exposed sites, such as the top of sea cliffs and barren islets along the coast, but occasionally, as on the ridge at the mouth of the Marino and on the slopes near OrangeTree Beach, it may be found in rather dense growth on thin soil in moderately sheltered places close to the sea.

The large sharp-pointed leaves, 1–2 dm. long and 5–10 cm. broad, are broadest above the middle and grow crowded towards the ends of the coarse branches. They are shed at the beginning of the dry season and not renewed until about May. The attractive flowers are white, funnelform, and very fragrant, and are produced in conspicuous terminal clusters, most abundantly during the first half of the rainy season. The fruit consists of a pair of strongly divergent, elongate cylindrical pods 10–15 cm. long and 10–12 mm. thick. At maturity the pods split down the inner side and after freeing winged seeds flatten out, dry, and persist as the straw-colored strap-like structures, several centimeters broad, that are to be found hanging on the plant at most seasons. The island form of this variable species is the form *acutifolia* (Aiton) Woodson and is native to Central America. (Fl. C. Z. p. 306). *Johnston 196; Erlanson 55.*

Rhabdadenia biflora (Jacq.) Muell. Arg.

A vine with milky latex growing in and about the mangrove swamps at Main Beach and at Playa Grande. It climbs on bushes and trees on the margin and in the drier parts of the swamp. At Main Beach its slender, sparingly leafy stems trail for long distances over the infrequently flooded parts of the swamp just back of the landing. The latex of the plant is reported in the books to be somewhat caustic, even blistering, but I did not find it so. The opposite leaves are thickish, slightly fleshy, and are rounded to acute at the ends and pale beneath. On climbing flowering stems they are mostly elliptic-oblong, 5–12 cm. long and 2–4.5 cm. broad. On trailing stems, however, they may be very narrow, even oblong-linear in outline, and only 8–15 mm. broad. The flowers are showy and handsome. They are white, becoming pinkish in age, and are funnelform and 6–7 cm. long. The species ranges along coasts from Florida and Mexico south into northern South America. (Fl. C. Z. p. 309, sub *R. paludosa*). *Johnston 725.*

Stemmadenia grandiflora (Jacq.) Miers HUEVO DE GATO

A shrub or slender tree with milky latex. It grows 3–10 m. tall and is one of the common and characteristic elements in the open woodland developed on areas of thin soil. While perhaps most abundant and generally distributed on the eastern peninsula it is to be found, in proper situations, in all parts of the island. Usually in the company of *Bombax* it is to be found on islets, about cliffs, and on headlands, and with *Bombax* and *Cedrela* also about outcroppings of rock on slopes and ridges. It grows only where the soil is thin and very dry during the rainless season, in fact, scarcely any such area is without it. Numerous good specimens of the tree, readily examined, grow on the rocky bank at the west end of Englishman Beach.

When cut, all parts of the plant ooze much milky latex. The opposite light green leaves are broadest above the middle and are narrowed to an acute base. They are 6–15 cm. long, 2–5 cm. broad, and have a petiole 2–5 mm. long. The bright yellow flowers have a tube 2.5–3 cm. long and a spreading limb 4–5 cm. broad, and are borne solitary or in small clusters along the leafy twigs throughout the year. The fruit is slightly fleshy, ellipsoidal, green, 3–3.5 cm. long and 2 cm. thick, and is usually produced in pairs. At maturity it splits down one side and spreads to reveal the seeds and the conspicuous red or orange placentas.

The species ranges from Costa Rica into northern South America. (Fl. C. Z. p. 308, sub *Tabernaemontana grandiflora*). *Johnston 152, 437, 796; Erlanson 20, 83, 259; Harlow 37.*

ASCLEPIADACEAE

Blepharodon mucronulatum Decne.

A very slender twining vine climbing thickety growth at East Harbor and at Max Point and on bushes about the margin of the Bald Hill grassland. When cut the plant oozes milky latex. The firm opposite leaves, 4–7 cm. long and 9–21 mm. broad, are lanceolate or rarely elliptic and are green above and pale beneath. The slender petioles are 5–12 mm. long. The small greenish or yellowish flowers are borne in small umbels along the stem during the rainy season, apparently in greatest abundance during its latter months. The rounded smooth green beaked pods are about 7 cm. long. The seeds have a white coma. The species ranges in Central America and northern South America. (Fl. C. Z. p. 311). *Johnston 31, 194, 430, 978; Erlanson 461; Harlow 27, 44.*

Fischeria funebris (Donn. Sm.) Blake

A coarse twining vine occasional in thickets and on forest margins in all parts of the island. The stems and foliage are darkened by an abundance of tawny or brownish bristles. When cut the plant oozes much milky latex. It grows rapidly during the latter half of the dry season; the new herbage, shaggy with brownish bristles, attracts attention as early as March. The opposite oblong or elliptic leaves, 8–14 cm. long and 3.5–7 cm. broad, are usually somewhat cordate at the base. The petioles are 1–2 cm. long. The white flowers are borne in umbellate clusters 4–6 cm. broad, produced along the leafy stems. They were first seen as early as the end of March but are apparently produced more commonly in May and June. When in full flower the plants make a fine display and are very attractive. The species ranges in Central America. *Johnston 554; Erlanson 184, 238, 267.*

Funastrum reflexum (Pitt.) Schlecht.

A slender vine growing over bushes in the clearing about the rock crusher at East Harbor. It oozed much milky latex when cut. The opposite leaves, 3–7 cm. long and 2–5 cm. broad, are distinctly cordate. They are green above, pallid beneath, and borne on petioles 1–3 cm. long. The white flowers are developed in crowded long-pedunculate umbels produced abundantly along the leafy stems. A good colony of the plant was found in November 1944, but no traces of it were found during subsequent visits to the island. The species has been previously known only from western Costa Rica. *Johnston 363.*

? **Macroscepis panamensis** Woodson

An occasional vine in the eastern portions of Area 11A, where it grows over thicket and climbs over 5 m. high in trees. The stems become 5 mm. thick and are bristly with brownish hairs. When cut they ooze a milky latex. The opposite ovate leaves, 15–20 cm. long and 11–14 cm. broad, are thickish and slightly fleshy and bear an abundance of short appressed brownish hairs. Their base is deeply cordate. The petiole is 3–7 cm. long and bristly. The plant, first detected in January 1946, was seen in sterile condition only. It

much suggests *Fischeria*, but differs in its larger, ovate, cordate-based, long-petiolate, and more sparingly veined leaves. The species is known only from Panama. *Johnston 1056.*

Marsdenia macrophylla (H. & B.) Fourn.

A rather coarse twining vine climbing high on forest margins. It was seen in all parts of the island but is not common. The main stems, 1–2 cm. thick, develop conspicuous longitudinal corky ridges. All parts of the plant ooze milky latex when cut. The large, thickish, slightly fleshy opposite leaves, 15–33 cm. long and 10–15 cm. broad, are green and somewhat lustrous above, pale beneath, and usually cordate at the base. The petioles are 3–6 cm. long. The small flowers are borne in compact umbels along the stems. Erlanson collected them July 23 and reports them as "glossy red." Plants observed in December and January mostly bore fruit. This hung from the cork-ridged leafless larger stems and had a hard smooth green shell. It was 15–17 cm. long and 4.5–5 cm. thick at or just below the middle. The fruit is not readily found, for it generally develops hidden among the leaves on the viny curtain up which the plant grows. When completely ripe the fruit splits down one side to free an abundance of comose seeds. The species ranges from Mexico to Venezuela. *Johnston 876; Erlanson 503.*

Marsdenia margaritaria R. C. Foster, spec. nov.

Suffrutex volubilis; rami vetustiores glabrati vel sparse puberuli, plerumque rugoso-suberosi; rami juniores subsparse adpresseque puberuli. Petioli 1–2.5 cm. longi, canaliculati, primum puberuli demum glabrati; laminae subcoriaceae, ad 11 cm. longae, ad 5.6 cm. latae, ovatae vel oblongae vel raro lanceolato-ovatae, basi attenuatae vel cuneatae vel rotundatae (rarissime subcordatae), apice rotundatae vel abrupte acutae vel acuminatae, nervo primario basi pluriglanduloso, marginibus ciliatis et revolutis, supra virides, nitidae, primum sparse puberulae demum glabratae, subtus pallidiores, non nitidae, sparse puberulae (praecipue ad nervos). Inflorescentia sat dense umbelliformis, pedunculus ad 7 mm. longus, adpresse pilosulus; pedicelli similes. Calycis lobi ovato-oblongi vel suborbiculati, obtusi, sat dense pilosuli, praecipue ad centrum, ad 2.5 mm. longi. Corollae tubus suburceolatus, albido-viridis, ad 4 mm. longus, extus glaber, intus contra dorsa staminum pilis longis, albis, rigidis, retrorsis ornatus; corollae lobi ovato-oblongi, obtuse rotundati, ciliati, 2.5–3 mm. longi, ad 2 mm. lati, brunneo-purpurei, margine pallidiore, intus praecipue ad basin puberuli; gynostegium corollae tubum non aequans, 3 mm. longum; antherae 1.4 mm. longae, membranae apicales ovato-oblongae, obtusae, 1.4 mm. longae, stigma fere aequans; corpusculus minutus, vix 0.2 mm. longus, pollinia obovoidea, ca. 0.6 mm. longa, caudiculi ca. 0.6 mm. longi; coronae squamae 1.8 mm. longae, carnosae, oblongo-ovoideae, dorsale planae ad antheras fere omnino adnatae, ventrale in ligula libera, lanceolato-deltoidea, obtusa, quam stigma late conicum perbreviore, prolongatae. Folliculus late ovoideus, ad 12–13 cm. longus, ad 4.5–5 cm. latus, infra dimidium latissimus, basi rotundatus, apice obtusus, glaber; semina pertenuia, complanata, pallide brunnea, margine tenebriore, ad 9 mm. longa et 6 mm. lata, coma juventute pallide brunnea, basi atrobrunnea, demun alba nitida, ad 6 cm. longa.

TYPE: *Johnston 1190*, San Jose Island, point west of Main Beach.

A twining vine growing over bushes along the coast, generally where the soil is thin and growing also on bushes and trees in the fringe of the forest

surrounding the grassland at Bald Hill. It was found on Punta del Cabo, near E. M. Beach, and near Main Beach, on the ridge at the mouth of the Marino, on the thin soil area at East Harbor and at Bald Hill.

The main stems become 5 mm. thick and somewhat shrubby, but develop no corky ridges. All parts of the plant bleed much milky latex when cut. The opposite, usually elliptic or elliptic-ovate (rarely lanceolate) leaves 6–11 cm. long and 2.5–5 cm. broad, are bright green and somewhat lustrous above and decidedly pale beneath. They are obtuse at the base, acute to obtuse at the apex and have a petiole 1–3 cm. long. The foliage is shed in late February and not renewed for a month or more. The brown flowers, crowded in umbels borne along the stem, are produced, after leaf renewal, in April and May. The fruit, 12–13 cm. long and 4.5–5 cm. thick, has a tough hard green shell. It is broadest below the middle, contracted towards the obtuse apex, and rounded at the base. During January it matured in sufficient numbers to become a conspicuous object here and there in the vegetation at East Harbor and Bald Hill.

The species is known only from San Jose Island. According to Dr. Foster, who studied and named the species, it belongs to the section *Ruehssia*, subsection *Mollissimae* and is sharply characterized by its corona, as well as by its minute corpuscle, long caudicles, and relatively large pollinia. It can be distinguished from its relatives *M. mollissima* Fourn. and *M. montana* Malme not only by its much more northern range but also by the shape and texture of its glabrous leaves. *Johnston 759, 827, 850, 981, 1190, 1212; Erlanson 156.*

Matelea viridiflora (Meyer) Woodson

A slender viny herb with elongate leafy stems that usually creep over the soil, rooting at the nodes, and only rarely twine weakly over low growth. When bruised or cut the plant oozes much milky latex. Along East Road near the Air Strip it grew abundantly, and for over a hundred yards carpeted large areas in the broad, shallow ditch at the roadside. Elsewhere it was seen only in disturbed soil on the east side of the road along Red Hill Grade. The plant grew only on previously cleared soil that had been constantly water soaked during the rainy season, and perhaps because of this was free of woody second growth. It showed no tendency to spread into areas of undisturbed vegetation near by.

The opposite leaves, 2.5–5 cm. long and 1.5–3 cm. broad, are light green and sparingly short-bristly above and pale beneath. Their apex is acute or frequently acuminate, while their base is rounded, cordate, or conspicuously eared. The flowers have a broad, shallow, greenish yellow corolla 2.5 cm. broad and are borne along the leafy stems. They were being produced abundantly when the plant was first detected late in December 1945. Though not showy, they were sprinkled in such numbers, like yellowish green stars, over the carpet of green, that they made an interesting design that was worthy of a pause for enjoyment. The fruit matures in February. It is a boat-shaped pod 7–8 cm. long and 2–2.5 cm. broad which is filled with seeds bearing a white coma. It is prominently 5-ribbed and has a broad flat back, a rounded base, and an acuminate apex.

The species ranges from Costa Rica into northern South America. Dr. Foster, who made a detailed study of the San Jose material, reports that

in pollen structure it is very unlike typical material of the species from the Guianas. (Fl. C. Z. p. 311, sub *Vincetoxicum viridiflorum*). *Johnston 845, 1310.*

CONVOLVULACEAE

CALONYCTION ACULEATUM (L.) House — MOONFLOWER

A coarse herbaceous vine growing on the clearing at the Navy Station and over shrubbery on the adjacent cliffs. The plant may be native, but I suspect that it was introduced by Navy personnel as an ornamental plant. It did not see it at the Navy Station in 1944. Erlanson, however, found plants just coming into flower on "coastal bluffs" in May 1945, and I found a number of thrifty plants, some in semi-cultivation, still flowering and fruiting when I visited the station in January 1946. The stems have a milky latex and frequently bear weak prickles. The broadly 3-lobed, light green leaves have a cordate base and are 5–20 cm. long and nearly as broad. The spectacular white flowers, with a slender tube 1 dm. long and a flaring limb nearly as broad, open only at night. The species is widely distributed in tropical America and is frequently cultivated. (Fl. C. Z. p. 314). *Erlanson 128.*

Evolvulus filipes Mart.

A very slender-stemmed annual herb which may grow erect, simple, and 1–3 dm. tall, but which usually develops many much-branched prostrate stems and forms dense low circular mats up to a meter broad. It is usually found in relatively open places where the soil is thin, generally in open deciduous woodland, about rock exposures on ridges and slopes, or on cliffs and on islets along the shore. It has numerous very small leaves 8–20 mm. long and 1–4 mm. broad. The small blue flowers, with a circular limb 4 mm. broad, may be developed in great numbers and can make a very attractive display. Flowering begins late in the rainy season and continues in diminishing amount until the plant dries up in January or February. The species is widely distributed in the tropics. *Johnston 318, 946.*

Ipomoea digitata L.

A coarse herbaceous twining vine climbing in the low trees on the bank at the head of the shingle beach at the west end of Canyon Road. When discovered, in February 1946, it was sending up new stems and had not produced flowers. The plant has slightly fleshy leaves 8–12 cm. long, composed of five elongate diverging sharp-pointed lobes 1.5–2 cm. broad. They are dark green above, pale beneath, and have a truncate base. The species is widely distributed in the tropics. (Fl. C. Z. p. 315). *Johnston 1408.*

IPOMOEA HEDERACEA (L.) Jacq.

A small morning-glory introduced at the Goat Barn in unclean hay shipped from southern United States. It was first collected at the Goat Barn by Erlanson in July 1945. In January 1946 it was still growing there in great profusion on the site where bales of hay had been piled, and had also appeared near the Dynamite Shack, where, in preparation for an orchard, straw and manure from the Goat Barn had been used for fertilizer. At San Jose the species appears to develop two generations a year, one at the beginning of the rainy season and the other at its close. Plants at the Goat Barn in January 1946 were flowering and were in a similar state of maturity to those

found there by Erlanson the previous July. By late February most had fruited profusely and had dried up.

The plant is an annual herb and forms either a bushy growth 1–2 dm. tall or only one or two elongate twining stems rarely over a meter long. The 3-lobed leaves have a cordate base and are 2–6 cm. long and 1.5–5 cm. broad. The funnelform corolla, 2.5–5 cm. long, is at first blue but changes to pink or magenta before withering. The sepals are linear-attenuate, 10–20 mm. long, and very bristly at the base. The species is native to southern United States, northern Mexico, and the West Indies. *Johnston 945; Erlanson 476.*

Ipomoea minutiflora (Mart. & Gal.) House

A small herbaceous vine with very slender stems. It grows prostrate, forming mats less than a meter broad, or it climbs about a meter, becoming loosely branched, and forms tangles in low vegetation. It was found on the eastern peninsula, in sunny open places on thin soil areas, and about rock exposures at Max Point and on the headland south of the entrance to Bodega Bay, as well as on the grassland at Bald Hill. The plant begins rapid growth late in the rainy season, comes into blossom about November, and continues to flower and fruit abundantly until it dries up late in January. When cut its vigorous stems ooze a milky latex. The leaves are heart-shaped, 1–2 cm. long, and are borne on slender petioles almost as long. The tiny orange corollas are campanulate and 6–8 mm. long. The species is found in Mexico, Central America, and northern South America. (Fl. C. Z. p. 315). *Johnston 377.*

Ipomoea pes-caprae (L.) Sweet

A coarse vine trailing here and there over beach sand at Main Beach and Long Beach and present in a very large colony at E. M. Beach. This is an ocean-distributed strand plant and is to be expected at Playa Grande, but was not found there. In January 1946 a vigorous plant was found growing from a broken sand bag on the grassland at Bald Hill, and, surprisingly, there was a colony of the plant well established near the road half way between Camp and the Garbage Dump. The latter was in a thicket area over a hundred yards back from high sea cliffs. The place had been cleared by bulldozers, and much waste lumber from the pioneering camp structures had been burnt there in late 1944. It was evidently an agreeable site for the plants, but how this seashore species got established there is a puzzle.

The stems of the plant are coarse and juicy and frequently bleed some milky latex when cut. The thickish ovate or elliptic leaves, notched at the apex, are 5–10 cm. long and 5–9 cm. broad. The pink funnelform flowers, 3–4 cm. long, are borne, one to several together, on peduncles rising from the prostrate leafy stems. The species is widely distributed on tropical beaches. Our plant is the most common form, the variety *emarginata* Hallier. (Fl. C. Z. p. 315). *Johnston 851; Harlow 90.*

Ipomoea triloba L.

A slender vine trailing over the ground or twining in low bushes. In 1944 it was found in open places with moderately thin soil in the area now occupied by the Air Strip, and in 1946 was seen in several places on cleared land about the Strip. It is certainly native. The stems, rarely more than

a meter or two long, spring from a deep, slender taproot. The leaves, 2–4 cm. long and 15–30 mm. broad, are usually deeply 3-lobed. The flowers, aggregated on elongate peduncles, have a funnelform violet-pink corolla 18–20 mm. long and lanceolate, sharp-pointed sepals, bristly on margins and back. The plant flowers during the first half of the dry season. The species is widely distributed in the American tropics. (Fl. C. Z. p. 315). *Johnston 544, 1023.*

Jacquemontia tamnifolia (L.) Griseb.

In November 1944 this plant was seen only on the open areas of thin soil on top of the sea cliffs at East Harbor and was then just coming into full flower. Most of the plants were erect, unbranched, and only a few decimeters tall. Only a few had developed elongate stems which were beginning to twine. The following March, however, old, mostly dried-up masses of this vine were to be found in new growth along roads in many parts of the island. By January 1946 it had become a common plant in second growth. The plant is annual. Its very slender twining stems form tangled, netted growths on shrubbery. The leaves are cordate and 2–6 cm. long and 1–4 cm. broad. The inflorescence is a peduncled globose cluster with many bracts which enlarges and may become 2–4 cm. in diameter in fruit. From it emerge the attractive, broadly funnelform blue corollas, about 12 mm. broad. The species is widely distributed in the tropics. (Fl. C. Z. p. 313). *Johnston 175; Erlanson 148.*

Merremia umbellata (L.) Hallier

A slender-stemmed vine trailing over bare ground or forming tangles over the new growth at roadsides. In November 1944 sterile plants of this species were observed in disturbed places near East Harbor. It was associating only with native species and appeared to be indigenous. The following March it was found growing over second growth along roads at various places on the island.

The leaves are ovate to lanceolate in outline, cordate at the base, 3–7 cm. long and 1–5 cm. broad. They are grayish with a soft velvety pubescence when young but become nearly glabrous above in age. The showy flowers are yellow, funnelform, and 2–2.5 cm. long, and are borne many together in umbellate clusters terminating axillary peduncles. They begin to appear in January but are probably most numerous in late February. The fruit is a globose capsule nearly 1 cm. broad which is embraced by the broad, rounded, enlarged sepals. The species is widely distributed in the American tropics. (Fl. C. Z. p. 315, sub *Ipomoea polyanthes*). *Johnston 534, 810.*

Stictocardia tiliaefolia (Desr.) Hallier

A coarse vine twining in the bushes overhanging the beach at the south end of Playa Grande. The coarse cordate leaves, 7–13 cm. long and broad, are green above and grayish and punctate beneath. The pink or purplish funnelform corollas are 7–9 cm. long. The fruit is a capsule containing several large seeds and is enclosed by the persisting, broad, much enlarged calyx lobes. The hard brown seeds are strigose and 7–9 mm. in diameter, and are freed by the ultimate disintegration of the capsule and its investing calyx. When discovered in January 1946, the plant was flowering and bore great numbers of young and old fruits.

The species is widely distributed in the tropics and is found chiefly back of beaches. Its seeds are apparently distributed by ocean currents. Recent authors have called this plant *Rivea* or *Stictocardia campanulata*, but as van Ooststroom, Blumea **3:** 568 (1940) & **5:** 347 (1943), has indicated, those names are based upon *Ipomoea campanulata* L., which is a very different plant. (Fl. C. Z. p. 312, sub *Rivea campanulata*). *Johnston 1011.*

BORAGINACEAE

Cordia alliodora (R. & P.) R. & S. LAUREL

A tree, usually 10–20 m. tall, which is most abundant on the northern half of the island. Numerous scattered individuals, standing here and there in thicket, are features in the landscape in the great thicket areas along the west side of San Jose. The tree is more abundant, however, in open mixed forests on the northern and eastern parts of the northern half of the island and along with *Cordia bicolor* is common along the East Loop and the road east of Red Hill. It generally occurs scatteringly. Only in a small area along the south side of the Air Strip is it sufficiently numerous to be a dominant forest tree.

The trunk, usually 2–5 dm. thick, has a grayish, narrowly furrowed bark. The wood is somewhat scented, and though white when fresh, it quickly becomes dark by oxidation. The crown is rather open, unkempt, and grayish green. The twigs of this species are very distinctive. They are unbranched for 1–2 dm., then they become irregularly swollen and produce numerous branchlets. The branchlets may develop a terminal swelling and produce other branchlets in turn. The swellings on the twigs are hollow. After an entry is gnawed into them they serve as nests for the vast number of tiny ants which always infest the tree.

The leaves, 8–18 cm. long and 3–7 cm. wide, are broadest near the middle and narrowed towards the acute ends. They are grayish green. Their upper surface becomes glabrous, but the lower one remains permanently clothed with minute stellate hairs. The petioles are 1–3 cm. long.

The inflorescence is much branched, forming globular masses 2–3 dm. broad, and springs from an apically swollen twig. The flowering season begins in mid-January and reaches its height in early February. For a time the tree is covered with snowy clusters of small white flowers, but these soon darken and persist in brown masses on the tree for many weeks. These masses of apparently dead flowers, and later the nearly bare inflorescences, which persist as dead twigs, give the tree an unkempt appearance, but they do help in identifying it from a distance during at least half of the year.

The flowers have a 10-ribbed cylindrical calyx, 4–5 mm. long and 1.5–2 mm. thick. The corolla has oblong divergent lobes 5–7 mm. long. Unlike the corolla of most plants it does not wither and fall away after the flower is pollinated. Without shrinkage or change in form it turns brown, dries, and never frees itself from the other parts of the flower. Eventually, when the fruit, which develops inside a sheathing of calyx and corolla tube, is fully ripe, the whole flower detaches, and then the stiff, dried, brown persisting corolla lobes function as a parachute. Aided by the wind they are instrumental in giving wide dissemination to this species. The actual fruit is a tiny cylindrical body just a few millimeters long, and only by subsequent decay is it ever freed from within the tube of calyx and corolla. Certainly

this fruit is very unobtrusive and it is not surprising that Panamanian woodsmen working on the island were insistent that the tree never fruited. It is doubtful if they were ever convinced that fruit was then actually developing in the apparently blighted masses of brown flowers present in such numbers at that time in late February. The species ranges from Mexico to northwestern South America. (Fl. C. Z. p. 318). *Johnston 570.*

Cordia bicolor DC. TABLE TREE

A tree 10–20 m. tall, most common on the northern half of the island. It is found in more or less open forests and frequently also in high thicket near forest margins, and is especially common in the open mixed forests along the East Loop. The tree has a distinctive aspect. In relation to the height of the tree its crown seems disproportionately small. This latter is made up of crowded, repeatedly forking, broad horizontal branches and is flat-topped and commonly 2–4 m. broad and usually only 1–2 m. deep. The trunk supporting it is usually 2–4 dm. thick and is covered with a gray, somewhat corky bark marked by fine longitudinal, lineate furrows. When cut the thick laminated bark is tan but quickly oxidizes to brownish.

Seedling trees frequently develop in disturbed soil along roads cut through forests. Unlike other second growth trees this one spreads laterally before it starts rapid growth upward. During their first year they form flat-topped circular growths 1–1.5 m. in diameter and 1–3 dm. deep, which rest on the ground. Subsequently, as the trunk develops, the flat-topped crown of horizontal branches is displayed higher and higher. Because of its more leisurely growth the tree does not appear in the rampageous, upward-surging second growth dominated by *Ochroma* and *Trema*. It pioneers on disturbed soils along forests roads where *Ochroma* and its associates are never abundant and where there is plenty of room for its early period of spreading growth. Away from forests the tree gets started in numbers along roads only on road-cuts and where the first vigorous growth of *Ochroma* and *Trema* has been cut to the ground.

The leaves on mature trees are 10–17 cm. long and 3–8 cm. broad and are grayish green and slightly harsh to the touch above and distinctly pallid from a coating of minute hairs beneath. The base is obtuse or rounded and the apex is acuminate. The petiole is 3–6 mm. long. The leaves of juvenile plants are different in appearance. They are smaller, more elongate, usually 6–12 cm. long and 3–4 cm. broad, and are somewhat brownish or tawny, more pubescent, and not at all pallid beneath. Renewing its leaves gradually, the tree always remains well clad. Its period of vigorous growth is early in the dry season.

The small white flowers are borne in great numbers in short-pedunculate, flat-topped, much branched inflorescences 5–15 cm. in diameter, which are produced at the forks of the leafy twigs or terminal on the outermost ones. General flowering begins in February and continues in decreasing amounts into April. When the trees first come into bloom they produce tremendous numbers of flowering inflorescences, but their color from a distance seems somewhat greenish or yellowish and makes surprisingly little display. The flowers on a given tree are functionally either male or female. They have a strigose, campanulate calyx about 2 mm. thick, from which the white limb of the corolla, 4–5 mm. broad, is exserted. The fruit matures at the end of

the dry season and is seated on the enlarged, saucer-shaped calyx. It is ovoid, 1 cm. long, and has a grayish coating of minute appressed hairs. Its pulp is glutinous.

The distinctive silhouette of this tree and its unusual form in the juvenile state result from its peculiar type of branching. The branches grow out horizontally and are regularly and repeatedly forked. The forking is usually dichotomous but may be trichotomous or rarely even tetrachotomous. The sections of the stems between successive points of forking are usually 15–20 cm. long and usually bear 4 or 5 leaves in a 2/5 phyllotaxy. The terminal outermost leaf on the stem-section always arises medially on the under side of the horizontal branch and very close to the forks and always displays its blade between them. The other leaves, borne along the stem-section and twisting on their petioles, are displayed left and right along the sides of the stem, usually with their blades lying all in the same horizontal plane. The leafy branches, accordingly, are usually pronouncedly dorsiventral. As had been noted, the terminal leaf on the stem-section is attached on the lower side of the twig close to the forks. The penultimate leaf on the section is also borne close to the forks but slightly lateral on the upper side of the twig and 3–10 mm. down along it below the attachment level of the terminal leaf. Its blade is always appreciably smaller than those borne elsewhere along the stem-section. The section, accordingly, bears 2–3 well separated leaves along its principal length, and, in addition, 2 leaves, a dorsal large one and a ventral small one, crowded at its forking terminal end. There are buds developed in the axils of all these leaves, but if any grow into shoots, it is almost always the one subtended by the small ventral leaf next to the forks. The forks of the stem are not subtended by leaves, scales, or other foliar structures, and are not axillary products. Morphologically they are subapical. Between the diverging forks on young twigs there is always present a tiny stiped irregular globular mass, 1–3 mm. in diameter, which represents an inflorescence arrested in an early stage of differentiation. On juvenile plants this eventually dries up and falls away, but on mature trees it can continue to grow into the large, loosely branched flower cluster of the species. It is terminal on the stem-section.

The peculiarities of growth habit in this species are the result of the stem organization just described. Seedlings of the plant send up a single erect stem that reaches 1–2 dm. in height before forking. The 2–4 forks produced develop into repeatedly forking, broad horizontal branches. If the plant got started at the beginning of the wet season, it may by the end of that season have formed a circular flat-topped crown of branches 1–3 dm. deep and 1–1.5 m. in diameter. This low, flat crown rests on the ground because the original erect basal stem section ceased to elongate when the first fork was developed. Well established now, the plant is ready for its first period of vigorous growth, which comes in this species during the first half of the dry season. At that time it sends up a vigorous erect central shoot that has its first forking 5–10 dm. above the top of the crown, then resting on the ground. The horizontal, repeatedly forking branches produced by the forks of the vigorous erect seasonal shoot eventually make a new, more elevated, flat-topped circular crown. The old crown is gradually shaded out and disappears. The following season another vigorous erect central shoot is sent up, which in its turn forks and develops a new, still more elevated crown

that shades out the older one beneath it. This process, repeated at least annually, gives the new plant a successively more elevated crown and more and more of a clear trunk. Plants kept under observation had lifted their crowns 1–2.5 m. at the end of two years. The crown is replaced and lifted annually only in vigorous young trees. In old trees, as new horizontal branches develop across the top of the large flat crowns, there is a thinning of the branches on the under side of the crown. Hence the crown becomes relatively higher above the ground but remains relatively constant in depth. The vigorous seasonal erect shoots by which the tree grows in height develop from the bud borne in the axil of the small penultimate leaf that is produced just below the first forking of the vigorous erect shoot of the previous season. The trunk of the tree, therefore, is formed of the initial stem-sections of shoots of successive seasons, and is therefore sympodial. The species ranges in Central America, the southern West Indies, and in northern South America. (Fl. C. Z. p. 318). *Johnston 417, 458, 545, 618, 620, 621, 785; Erlanson 256.*

Cordia ferruginea (Lam.) R. & S.

A loosely branched, slender-stemmed shrub common in thickets and frequent as a clamberer on forest margins. The plant has a somewhat sage like odor. Its stems are more or less flattened and the younger parts are brown from an abundance of minute hairs. They may become very elongate and are abundantly and widely branched. The firm ovate to lanceolate leaves, 4–12 cm. long and 2–7 cm. broad, are green, rough above and pale and finely hairy beneath. The base of the petiole becomes decurrent on the branch developing from its axil and persists as a hard, decurved woody prong 4–10 mm. long, which, hooked over stems, supports the plant in clambering.

The inconspicuous, sessile, yellowish, fragrant flowers are borne in loose spikes that eventually become very elongate, 8–15 cm. long, and interrupted in fruit. The small juicy red fruit, 4–5 mm. thick, is seated in an enlarged cup-like calyx. The plant begins its vigorous vegetative growth before the close of the wet season and has several marked periods of flowering and fruiting during the dry season. The species ranges from Mexico to northwestern South America. (Fl. C. Z. p. 318). *Johnston 120, 592, 907, 980, 1325; Erlanson 47, 59, 191; Harlow 96.*

Cordia panamensis Riley

A tree 3–12 m. tall, usually growing widely scattered in high thicket and open forest, and generally most frequent within a half mile of the coast. The species, however, is locally most frequent and is certainly most readily observed at Bald Hill, where numerous individuals may be found scattered in the edge of the forest margining the grassland. Some particularly large individuals may be seen by the road at the start of the jeep trail down the northern border of Area 11D. Occasional young trees are to be found here and there in second growth along roads, particularly near the coast, and especially in the vicinity of Camp.

The tree has a small, generally open and commonly irregular crown of rather large leaves. Its trunk is 5–20 cm. thick and has a smooth pale bark. Its branches are irregularly forked. The twigs are usually coarsely hairy. The leaves are stiff, rough, and grayish, or rarely somewhat brownish green on the upper surface and short-hairy and paler on the lower face. There are

two forms. Most of the leaves are lanceolate, usually broadly so, and 15–30 cm. long and 7–15 cm. broad. They are acute to rounded at the base and acuminate at the apex. The petiole is 5–10 mm. long. Among these large leaves are others that differ conspicuously in size and form. These latter are broadly ovate to suborbicular, 6–12 cm. long and nearly as broad. They occur at the forks of the twigs or close to a large leaf along an unbranched section of the twig, and are practically always found near any inflorescence. About a fifth of the total number of leaves are of this small sort. The tree sheds all its foliage late in February, and after remaining naked for about two months, starts vigorous growth in May, grows new foliage, and comes into flower about the first of June.

The many-flowered, flat-topped inflorescences are loosely and repeatedly branched, 5–20 cm. broad, and are produced along or at the ends of the leafy twigs or at their forks. The trees are unisexual. The flowers of the male trees are most conspicuous. These have a campanulate calyx 2 mm. thick, from which project 5 corolla lobes and 5 stamens. The corolla is white and has a limb 4–6 mm. broad. The female flowers, in contrast, have a more cylindrical calyx 1–1.5 mm. thick, and from it protrude smaller corolla lobes and a style. Their corolla limb is 2–4 mm. in diameter. Fruit is matured during the middle of the wet season. It is ovoid, glabrous, 8–9 mm. long, and ascends obliquely from an enlarged saucer-shaped persistent calyx. It is greenish or whitish when mature, but subsequently blackens and has a very glutinous pulp surrounding a rough stone.

In the fundamental organization of its shoots this species shows many similarities to *Cordia bicolor*. The chief difference is that in the present species the stems are not regularly forked. The stem-sections which I have described for *C. bicolor* can be detected in *C. panamensis*. They are, however, obscured because, of the 2–3 extra-axillary subterminal branches which give the regular forking in *C. bicolor*, all but one is commonly suppressed in *C. panamensis*. When the stem of *C. panamensis* is forked, the large terminal leaf of the stem-section is exposed between the forks, and the penultimate smaller circular leaf originates ventrally and close to the forks just as in *C. bicolor*. When only one branch develops and no fork is formed by the stem-section, the successive sections pass from one into another without any conspicuous break. Morphologically, however, their limits can be determined. When no fork is developed, the inflorescence appears to be borne laterally on the stem, though actually it terminates a stem-section. The presence of the distinctive small circular penultimate leaves which may occur at intervals along an unbranched twig are also morphological landmarks. Just as in *C. bicolor*, it is the vegetative bud in the axil of the small penultimate leaf of the stem-section which normally makes the new shoots in *C. panamensis*. The new growth each season springs chiefly from this bud. The species ranges from Salvador to Panama. (Fl. C. Z. p. 318, sub *C. heterophylla*). *Johnston 51, 79; Erlanson 226, 276, 446; Harlow 17.*

Tournefortia bicolor Sw.

A clambering shrub climbing over bushes or rarely up to 10 m. in trees. It is uncommon on the island and was seen in very limited numbers in trees on the outer headland of Punta del Cabo, in thickets back of E. M. Beach, in trees near Main Beach, in trees at OrangeTree Beach, in thickets along

Canyon Road, in thickets near the mouth of the canyon draining Area 11B, and on a sandbar along the Rio Marino below Red Hill. The plant starts vigorous growth early in the dry season and flowers and fruits during that season. The leaves, ovate to elliptic, 5–18 cm. long and 2.5–9 cm. broad, have an unusually bright green and lustrous upper surface. New leaves, especially those developed early in the season, may bear numerous appressed hairs, but eventually become glabrous. The white flowers, with tubes 3–4 mm. long and limbs 4–6 mm. broad, are borne unilaterally along the forked, uncoiling branches of the terminal inflorescence. The fruit is a white berry about 7 mm. in diameter, matured late in the dry season.

The species is widely distributed in tropical America. The juvenile, strigose phase of the species was described from Panama as *T. Billbergiana* Beurl. (Fl. C. Z. p. 319). *Johnston 629, 758, 1355; Erlanson 3, 87, 140; Campbell 3.*

Tournefortia syringaefolia Vahl

A slender-stemmed, shrubby plant growing over thickets in various parts of the island, generally not very abundant nor conspicuous. The leaves, ovate to elliptic, 5–12 cm. long and 2.5–5 cm. broad, are green above and paler beneath and are sparingly strigose when young but soon become glabrous. The plant flowers towards the close of the dry season and matures its fruit early in the wet season. The inconspicuous flowers, 4–5 mm. long, have a slender tube and minute cuneate yellowish green lobes. They first appear in May and are borne in large numbers along one side of the branches of the loose terminal inflorescence. The fruit is usually 4-lobed, juicy, orange-colored and about 5 mm. broad. The species is widely distributed in the American tropics. (Fl. C. Z. p. 319, sub *T. peruviana*). *Erlanson 114, 150, 190, 241, 249, 379, 388, 501.*

VERBENACEAE

Aegiphila laeta HBK.

In October 1944 a few flowering and fruiting plants of this species were found in the thickets along the outer portion of Bald Hill Road near the north end of the island. It was seen nowhere else and not detected on subsequent trips to the island. The plant, a small shrub 1.5–2.5 m. tall, has an erect stem that bears numerous horizontal leafy branches towards its summit. The light green opposite leaves are 6–10 cm. long and 2.5–4 cm. broad. The small greenish yellow flowers and later the orange-colored berries, about 4 mm. in diameter, are borne in small long-peduncled cymes that hang down from the leafy horizontal branches along which they are borne. The species is known only from Panama and northwestern South America. *Johnston 56.*

Avicennia bicolor Standley

A tree 4–12 m. tall, found only at the north end of the mangrove swamp back of Playa Grande. It is associated with scattered individuals of *Laguncularia* and *Rhizophora* forming a single small grove in infrequently and shallowly inundated soil at the drier end of the swamp. In general appearance the larger trees much resemble those of the more common *Avicennia nitida*, and especially as it is developed less than a half-mile to the northward in the swamp forest at the mouth of the Rio Marino. It is, however, readily distinguished from *A. nitida* by its larger fresh-green leaves, distinctly four-sided twigs, and large much-branched inflorescences.

The tree has a trunk 3–8 dm. thick, relatively few massive branches, and a large, spreading, rounded crown. Coarse woody forked aerial roots, 1–3 dm. long and 8–12 mm. thick, are produced in profusion and form crowded masses on the under side of most lower branches and on the lower side of all leaning trunks. The twigs are distinctly quadrangular and very brittle. The opposite leathery leaves, 8–14 cm. long and 4–8 cm. broad, are elliptic or ovate, bright green above, and usually pale and salt-encrusted beneath. The petiole is 1.5–2 cm. long. The white flowers, 6–7 mm. broad, are borne plentifully in a loose, much-branched pyramidal inflorescence 8–15 cm. long. Most of the trees were flowering when the colony was first discovered in January 1946. The species is known only from the Pacific coast of Central America. (Fl. C. Z. p. 321). *Johnston 1259.*

Avicennia nitida Jacq. BLACK MANGROVE

A tree 3–15 or rarely 18 m. tall, growing along the coast in places shallowly inundated by tides. A single large specimen grows near the stream mouth at the east end of Main Beach, limited numbers of moderately large plants grow with *Laguncularia* on the shingle beaches at Navy Cove and at the end of Canyon Road, but good stands of the tree occur in the swamp forest at the mouth of the Rio Marino. At the latter place, especially on the east side of the main stream, it forms numerous groves, interspersed in the forest of *Laguncularia,* on the more shallowly inundated and better drained portions of the swamp. The large trees, mostly 10–15 m. tall, have stout symmetrical trunks 2–9 dm. thick which, a few meters above the ground, develop heavy ascending branches that support a rounded, light green crown 9–12 m. broad. The rather smooth bark is gray or dusky. Coarse woody forked aerial roots, very similar to those found on *A. bicolor,* are frequently developed in dense crowded masses on the under side of the lower branches and on the lower side of leaning trunks. Great numbers of asparagus-like pneumatophores project from the mud under and about the trees.

The leathery opposite oblanceolate leaves, 7–15 cm. long and 2–4 cm. broad, are light green above and grayish green and frequently salt-encrusted beneath. The whitish flowers, 7–9 mm. broad, are borne in small globular clusters terminating the several pairs of very short branches which make up the small terminal inflorescence. The leathery fruit, 1.5–2 cm. long, is brown, laterally compressed, rounded at the base, and pointed at the apex. The species is widely distributed along coasts in tropical America. (Fl. C. Z. p. 321). *Johnston 1129, 1295; Erlanson 120.*

Callicarpa acuminata HBK.

A bushy, slender-stemmed shrub 2–4 m. tall, common in thickets, and particularly in those along the western side of the island. It is one of the very common species in the thicket growth about Camp. Its broad, sharp-pointed, frequently toothed opposite leaves are 10–12 cm. long and 5–10 cm. broad. They are light green above, and beneath, like the twigs, are grayish or somewhat tawny from a dense coating of small stellate hairs. The very small whitish flowers are produced abundantly in flat-topped, much branched clusters 5–10 cm. broad, which spring from the leaf axils along the twigs. The fruit is a small black globose berry about 3 mm. in diameter. The species ranges from Mexico to northwestern South America. (Fl. C. Z. p. 322). *Johnston 6; Erlanson 5.*

Citharexylum caudatum L.

A shrub or slender tree, 1.5–10 m. tall, frequent on seaward slopes on Punta del Cabo and about the head of the cliffs at the Navy Station, but occasional in the dense vegetation on the low cliffs near South Beach. Erlanson collected it in Area 8A. The opposite leaves, 8–12 cm. long and 2–4 cm. broad, have an acute base and an obtuse apex. The petiole is 5–10 mm. long. The white flowers, 3–4 mm. broad, and later the at first orange or red, then shiny black berries, 5–6 mm. thick, are borne in slender, very elongate, pendent racemes. They are produced in great numbers, and, when present, are very decorative and make the tree easily recognizable. The species ranges in the West Indies and from Mexico to Panama. (Fl. C. Z. p. 322). *Johnston 228; Erlanson 23, 310, 358; Harlow 5.*

Cornutia microcalycina Mold.

Known from the island only from a collection made by Erlanson on June 20 in the thickets near Bald Hill. It is reported to be a shrub 2.5 m. tall. The opposite leaves are 10–15 cm. long and 6–8 cm. broad and perhaps even larger. They bear minute grayish hairs and are green above and gray beneath. They are contracted towards both ends and have a coarsely and irregularly sinuate-dentate margin. The petiole is 8–20 mm. long. The flowers are bluish violet and are borne in a much branched, stiff, elongate, colored cymose panicle about 1 dm. long.

The species is known from Panama, Colombia and Ecuador. The form found on San Jose is that described as the var. *pulverulenta* Mold. (Fl. C. Z. p. 322, sub *C. grandifolia*). *Erlanson 311.*

LABIATAE

Hyptis capitata Jacq.

A coarse herb with slender somewhat decumbent stems 1–2 m. long. It was seen on the fill of Red Hill Grade and at the Navy Station in April 1945, and in January 1946 at Camp, near the bridge at the Goat Barn, and again at the Navy Station and on the fill at Red Hill. It occurred invariably with one or more immigrant weeds, and like them was probably introduced from the mainland. The species is widely distributed in tropical America. (Fl. C. Z. p. 326). *Johnston 688, 1088; Erlanson 48.*

Hyptis lantanaefolia Poit.

A slender-stemmed perennial herb up to 9 dm. tall, growing among grass in the damper places at the margin of Bald Hill grassland. In January 1946, along with some other grassland species, it was found to have become well established on the bank of a road cut over a quarter-mile north from the grassland. Widely distributed in tropical America, chiefly on grasslands. (Fl. C. Z. p. 326). *Johnston 46, 1208; Erlanson 479.*

Hyptis pulegioides Benth.

An erect, unbranched annual herb 1–3 dm. tall, growing on thin soil above the sea cliffs at East Harbor and on thin soil on the steep seaward slopes near OrangeTree Beach. The species is widely distributed in tropical America. *Johnston 821, 951.*

Hyptis recurvata Poit.

A slender annual herb, occasional on thin soil above the sea cliffs at East Harbor. Here the plants are usually 1–3 dm. and only rarely as much as 5 dm. tall and have very slender erect or ascending stems. A rank, coarse, much branched form of the species, up to 12 dm. tall, was found growing in disturbed soil at the head of the sea cliffs at the Garbage Dump. The species is widely distributed in tropical America. (Fl. C. Z. p. 326). *Johnston 675, 825, 1294.*

Hyptis suaveolens (L.) Poit.

A large, coarse, strongly scented herb up to 2.5 m. tall, growing on disturbed thin soil back of the sea cliffs (near the observation post) at East Harbor. Young plants were first observed there in October 1944. Limited numbers of mature fruiting plants were again seen in April 1945 and in January 1946. Although growing on disturbed soil, the plant remained localized in a very limited area and associated with no recently introduced weeds. It seemed to be native. Mature plants, associated with a variety of weeds, were discovered in January 1946 on the clearing behind the swamp at Main Beach. These latter plants, few in number, possibly represented a recent introduction from the mainland. The species is widely distributed in tropical America. (Fl. C. Z. p. 326). *Johnston 676.*

Marsypianthus Chamaedrys (Vahl) Kuntze

A small decumbent annual herb occasional on thin soil above the sea cliffs at East Harbor. The species is widely distributed in tropical America. (Fl. C. Z. p. 326). *Johnston 820; Erlanson 444; Harlow 75.*

Salvia hyptoides Mart. & Gal.

An erect annual herb, 3–12 dm. tall, occasional on areas of thin soil on the eastern side of the island. It was found in openings in deciduous forest at many places on the eastern peninsula and in similar situations near the coast east of Area 8D, near Mango Beach, and even on a small rock exposure along the boundary between Areas 3 and 4 about a half-mile east from South Road. The species ranges from Mexico to northwestern South America. (Fl. C. Z. p. 325). *Johnston 966, 1068.*

Salvia occidentalis Sw.

A sprawling weed found to be established in limited amounts in the lawn at Camp in January 1946. Obviously introduced from the Isthmus. The species is a widely distributed weed in tropical America. (Fl. C. Z. p. 325). *Johnston 1041.*

SOLANACEAE

Cestrum latifolium Lam.

A light green unobtrusive bush or small tree, 2–3 m. tall, growing very widely scattered in thickets. Only a few dozen individuals of the species were observed on the island. One was found in the valley bottom along the power line about a half-mile west of the Goat Barn, several more were seen along Dead End Road, and the largest number was scattered along the Loop between Canyon Road and Met Road. They were found in greatest abun-

dance in low gray thicket west of the Loop between Canyon and Dead End Roads. Erlanson has a collection from Area 11B.

The lanceolate to elliptic-ovate leaves, 10–14 cm. long and 4–7.5 cm. broad, are light grayish green and have a minute crisped oily pubescence on the petiole and midrib. The petiole is 1.5–2.5 cm. long. The slender trumpet-shaped whitish flower, 1.5–2 cm. long, has a slender elongate tube and narrow spreading lobes about 3 mm. long. The flowers are borne in small racemes in the leaf axils. Erlanson has flowering specimens collected at the end of June. I found a fruiting plant early in November and saw perhaps a dozen flowering plants during January. The fruit is broadly ellipsoidal, greenish, and 4–5 mm. in diameter.

The species ranges in Panama, the West Indies, and northern South America. I am indebted to Dr. C. V. Morton for the identification of this plant. (Fl. C. Z. p. 329). *Johnston 439; Erlanson 404.*

PHYSALIS ANGULATA L.

A few fruiting specimens of this herb were found growing as a weed in the lawn at Camp in January 1946. It is a nearly glabrous annual 3–9 dm. tall, having leaves cuneate at the base. The plant was obviously a recent introduction from the mainland. The plant is widely distributed in tropical America. (Fl. C. Z. p. 328). *Johnston 993.*

PHYSALIS PUBESCENS L.

A weed well established in disturbed soil along East Road near the Air Strip. It was flowering and fruiting when first detected in January 1946. It is a grayish erect annual with a pale slimy indument of fine glandular hairs and broad angulate leaves very oblique at the base. The plant was obviously introduced from the Isthmus. The species is widely distributed in tropical America. (Fl. C. Z. p. 328). *Johnston 1105.*

Solanum extensum Bitter

A common slender-stemmed shrub clambering in thickets in all parts of the island, but most abundant in the Low Gray Thicket in which it is one of the dominant plants. By early 1946 it was beginning to appear in one- to two-year-old second growth along roads and to give promise of becoming common in that environment. In uncrowded open places the plant can form an erect loose bushy growth 1–2 dm. tall. Usually, however, it is more or less clambering. Along forest margins it can be frequently seen scrambling up to 5–7 m. above the ground.

The twigs and foliage are densely clothed with slender, soft, slightly yellowish hairs and are usually somewhat oily and clammy to the touch. The lanceolate leaves, 4–15 cm. long and 1.5–5.5 cm. broad, have an acuminate tip and a base that is abruptly contracted into a petiole 2–5 cm. long. The white flowers, about 15 mm. broad, are borne in umbellate clusters along the leafy stems. They are to be found at all seasons, but apparently most abundantly late in the dry season. The fruit is a black globose berry 8–9 mm. in diameter which is usually loosely embraced by the broad erect calyx lobes.

The species is known only from Panama. It has, however, a very close relative in the perhaps inseparable *S. Edwardsii* Standl. of British Honduras

and Honduras. A specimen from San Jose, made by Andersson in April 1852, was one of the three upon which Bitter founded the present species. (Fl. C. Z. p. 330). *Johnston 101, 537, 1035; Erlanson 22, 386.*

Solanum isthmicum Bitter

A loosely branched, thorny shrub up to 3 m. tall. Andersson collected specimens of this species, with flowers and persisting old fruiting pedicels, during his visit to San Jose in late April 1852. I found the species only about the old clearing behind the swamp at Main Beach, on which the pioneering Army Engineers made their first camp in January 1944. Some juvenile plants, then unrecognized were observed on the clearing in March 1945. In January 1946 there were numerous young plants a meter or less tall and several large ones apparently producing their first flowers. They were scattered on the clearing and along the adjoining roadside and along the first fifty yards of the Cut Off. The plant was seen nowhere else on the island. Its behavior was that of a plant recently established and just beginning a rapid spread.

The twigs and foliage have a grayish coating of minute stellate hairs. The twigs and branches are armed with scattered straight thorns 1–7 mm. long, as are occasionally the petioles and back of the leaf blade also. The leaves are 6–25 cm. long and nearly as broad, and have an obviously 5-angled outline and a broad very asymmetrical base. The petiole is 2.5–10 cm. long. The white flowers, nearly 3 cm. broad, are borne in cymes along the twigs. No fruiting plants were seen.

The species is known from Costa Rica, Panama and Colombia. It has been identified with plants of Mexico and northern Central America and passed as *S. ochraceo-ferrugineum* (Dunal) Fernald or under the non-valid name *S. diversifolium* Schl. (non H. & B.), but is readily distinguished by its more southern range, erect fruiting pedicels, and smaller fruiting calyx. The type, *Fendler 254,* was collected at Chagras, Panama, and was originally described under the homonym, *S. Fendleri* Heurch & Muell. (1871) non Gray (1856). (Fl. C. Z. p. 331, sub *S. diversifolium*). *Johnston 1009; Andersson.*

Solanum lanceifolium Jacq.

A slender-stemmed shrubby clambering plant that is armed on stems and leaves with numerous vicious claw-like thorns. In undisturbed parts of the island it is infrequent and is confined to bushy open places along the coast, chiefly on cliffs and headlands. A year after the Army landed on the island, it began to appear in second growth and to multiply in this new environment. By January 1946, without the use of a machete, passage through much roadside growth had become an annoying, even painful task, because of the long, tough stems and the very sharp clawing thorns of the plant. Though its abundance in roadside second growth might suggest that it is an introduced weed, I am convinced that it is native on San Jose. Andersson collected it there in April 1852. I found it at a variety of places along the coast, such as Hicaco Island and the outer tip of Punta del Cabo, which were seldom visited and were far from landings, settlements, and roads.

The leaves, 7–18 cm. long and 2.5–6 cm. broad, bear scattered small stellate hairs and are green above and paler beneath. The midrib on the lower surface bears numerous thorns. The flowers, nearly 3 cm. broad, are white

flushed with pink and are borne in clusters along the stem. The lustrous globose fruit is orange when mature and 10–12 mm. in diameter. The plant seems to flower and fruit throughout the year. The species ranges from Mexico and the West Indies south into northern South America. (Fl. C. Z. p. 331, sub *S. scabrum*). *Johnston 328, 848, 872; Erlanson 6; Harlow 18, 101.*

SOLANUM NIGRUM L.

A small spreading herb bearing its tiny white flowers, and later its black globose berries, in small umbels along the stem. In January 1946 it was found to be locally well established in the clearings along the main road between the Cross Roads and the Goat Barn. It grew with other weeds and had obviously been introduced from the mainland. The species is a widely distributed weedy plant. (Fl. C. Z. p. 330). *Johnston 1119.*

Solanum perattenuatum, sp. nov. PLATE 17, FIG. 2.

Frutex 18 dm. altus graciliter divaricateque ramosissimus inermis; ramis teretibus pallidis, juventate breviter villosis cum pilis 1–2 mm. longis basi breviter basaliterque stellato-ramosis vestitis, maturitate sub glabrescentibus; internodiis quam foliis brevioribus; foliis alternis subochraceo-viridis subviscidis; lamina folii lanceolata vel lineari 5–10 cm. longa 1–45 mm. lata non rariter 10–50-plo longiori quam lata, utroque molliter sed haud conspicue brevi-villosa pilos 1–2 mm. longos simplices et pilos basaliter breviterque stellato-ramosos gerenti, infra medium latiori deinde basim versus in petiolum gradatim attenuata, supra medium apicem versus in acumen subulatum vel flagellatum pergracilem 10–15 mm. longum gradatim perattenuata, margine integra; inflorescentia umbellata laterali nullo modo axillari saepe e medio internodi ortis, pedunculo 1–4 mm. longo 2–7-flori, pedicellis gracillimis rectis 1–2 cm. longis; calyce fere ad basim lobato, lobis 5 lanceolatis vel lanceocuneatis 4–5 mm. longis et 1–1.8 mm. latis sparse breviterque villosis apice acutis, fructiferis ad 8 mm. longis et 2.5 mm. latis laxe recurvatis subglabrescentibus; corolla alba 13–15 mm. diametro profunde lobata, lobis 5 lanceolatis 4–5 mm. longis basim versus 1.5–2 mm. latis, apice acutis, extus apicem versus sparse pilosis; staminibus aequalibus; antheris ellipsoideis ad 2 mm. longis ca. 1 mm. latis utrinque emarginatis; bacca nigris subglobosis ad 6 mm. diametro.

TYPE: *Johnston 909,* San Jose Island, Main Camp, a single plant in second growth.

A shrub with slender, widely and loosely branched pallid stems. It was observed only twice, once across the road from the Guard House at Camp and again on Dead End Road near the start of the trail into Area 11B. At both places it grew near *S. extensum* in second growth at the roadside, and formed a loose, light green bushy growth about 18 dm. tall. Only two individuals were seen. Their leaves are distinctive. They tend to hang downward from the twigs and are 5–10 cm. long, and though rarely as much as 45 mm. broad, are usually only 1–10 mm. in width. They are commonly broadest near the middle and are contracted very gradually downward into the petiole and upwards into their usually whip-like apical attenuation. On vigorous twigs the leaves may be practically linear in form with the widest portion of the blade no more than 1–2 mm. broad. The foliage is sparsely clothed with short erect hairs that are stellately branched at their bases. The slightly yellowish indument resembles that of *S. extensum* in being somewhat oily, but is much more scanty than in that species. The white flowers

much resemble those of *S. extensum* and differ chiefly in having lanceolate, acute sepals. The fruit is a black globose berry about 6 mm. in diameter, which is supported at the base by an accrescent calyx having sharply pointed, sparingly hairy, recurving, lanceolate sepals, rather than the oblong, very hairy, obtuse, erect, or ascending sepals found in *S. extensum*.

The species is known only from San Jose Island. It is related to *S. extensum*, but differs in its more sparse, villous indument, in its narrow, acute, lanceolate sepals, and in its elongate, very long-attenuate, long-petiolate leaves. The plant is greener and is much more bushy and open in growth than is its relatives. Its very elongate leaves tend to be pendulous. They are mostly drawn out very gradually into a conspicuous flagellate tip, some becoming so narrow as to be almost linear in outline. Their acute base is very gradually contracted into a long petiole. Though *S. perattenuatum* differs sharply and conspicuously from the common *S. extensum* of San Jose, there is the possibility that it may represent only a phase of the latter species, perhaps one resulting from virus infection. In any case, with appearance and characters so distinct, the plant certainly merits a name. *Johnston 909, 1034.*

SCROPHULARIACEAE

BACOPA PROCUMBENS (Mill.) Greenm.

A small prostrate light green herb with yellow flowers growing in the lawn at Camp. It was well established, but still uncommon, when first discovered in January 1946. Obviously introduced from the mainland. The species is widely distributed in tropical America. (Fl. C. Z. p. 336). *Johnston 1249.*

Buchnera sp.

A slender erect herb confined to thin soil above the sea cliffs at East Harbor. The four collections from this locality have notes giving the flower color as white, purplish, lavender, and very light blue. Until this genus is given a detailed study and the characters of the species worked out, worthwhile identifications of the plants are impossible. Accordingly no specific identification of this island *Buchnera* is given. It appears to be similar to plants found in Costa Rica, Panama, and Venezuela. (Fl. C. Z. p. 334). *Johnston 180; Erlanson 529; Harlow 77.*

CAPRARIA BIFLORA L.

A bushy herb up to a meter tall bearing numerous coarsely and sharply toothed oblanceolate leaves 2–5 cm. long. The small white flowers are borne along the leafy twigs. The plant is well established about the landing at Main Beach, where it was first detected by Erlanson in May 1945. In January 1946 it was also found at the Navy Station. The species is a weedy one and was obviously introduced from the Isthmus. Widely distributed in the American tropics. (Fl. C. Z. p. 335). *Erlanson 223; Harlow 60.*

SCOPARIA DULCIS L.

A bushy herb a few decimeters tall, bearing its toothed oblanceolate leaves, 1.5–2.5 cm. long, in whorls of three. The small flowers are white. The plant was evidently introduced from the Isthmus. It was a well established weed at the Navy Station when first observed there in November 1944. The species

is widely distributed in the tropics. (Fl. C. Z. p. 336). *Johnston 764; Erlanson 132.*

STEMODIA DURANTIFOLIA (L.) SW.

An erect-growing viscid herb with spikes of small purple flowers. It is an introduced weed which was well established in the lawn about the chapel at Camp when first discovered in January 1946. The species ranges widely in tropical America. (Fl. C. Z. p. 335). *Johnston 1202.*

BIGNONIACEAE

Adenocalymma inundatum Mart. ex DC.

Observed only in the swamp forest at the mouth of the Rio Marino. Several large plants were found growing with *Mora* and *Laguncularia* near a lateral channel in the better drained portions of the swamp east of the main stream but still in terrain that was periodically flooded. It grew in small openings in the swamp forest, and its stems, 2–4 cm. thick, arose from the muddy soil in more or less erect loops and coils, forming loose tangles 10–15 dm. tall and 5–10 sq. m. in extent, and only occasionally climbing into the low trees near by. The opposite compound leaves had three leaflets. Those on vigorous shoots had the middle leaflet replaced by a simple tendril. The leaflets were ovate or oblong-ovate, 8–15 cm. long and 4.5–8 cm. broad. Their base is rounded or somewhat truncate and their apex is contracted into a distinct slender acumination 10–15 mm. long. No flowers nor fruit were present when the plants were discovered in February 1946.

The species has been reported only from the Guianas and Amazonian Brazil, but is apparently represented by the plant, flowering in July, which was collected at Salamanca Hydrographic Station, Canal Zone, by Woodson, Allen & Seibert, no. *1577*. This collection very closely matches and is almost certainly conspecific with the plant found on San Jose at the mouth of the Marino. *Johnston 1296.*

Amphilophium paniculatum (L.) Kunth

A loosely branched woody vine frequent in thickets and occasional in forests on the northern and western parts of the island. Its large main stems, 4–6 cm. thick, looped and coiled about trees and then soaring aloft to the canopy, are a not infrequent sight in the forests. The twigs of this vine are distinctive. They have six strong pallid longitudinal ribs and are accordingly hexagonal in cross section. When young they are more or less minutely brown-pubescent and glanduliferous. The opposite compound leaves have two leaflets and frequently an interposed simple tendril. The broadly cordate to ovate leaflets, 5–11 cm. long, are more or less distinctly cordate at the base. Their dull surfaces are clothed with minute brownish pubescence and glands. The flowers, about 3 cm. long, are purple but fade to white before falling. They are borne in terminal panicles or in axillary clusters. The calyx is unusual in form, being hemispheric or subglobose and surmounted by a broad, spreading, ruffled limb. The woody oblong strongly biconvex pod is 7–12 cm. long, 3–3.5 cm. broad, and 1.5–2.5 cm. thick. The plant apparently flowers at all seasons, but perhaps most abundantly at the end of the rainy season. The white flowers with their peculiar calyx, fallen from the canopy above, attract

attention when encountered on the forest floor. The species ranges from Mexico and the West Indies south into northern South America. (Fl. C. Z. p. 338). *Johnston 422, 664; Erlanson 64.*

Anemopaegma orbiculatum (Jacq.) DC.

A common woody vine in thickets and on forest margins over the northern and western parts of the island. The opposite compound leaves have 3–5 leaflets, with the medial one frequently replaced by a branched tendril. Many of the leaves on a plant are palmately 5-foliolate. These distinctive leaves, and also the branched tendrils, make the plant easy to identify. The leaflets are lanceolate to lance-ovate, pale green, 3–15 cm. long and 1.5–6 cm. broad. They are obtuse to rounded at the base and pointed at the apex. The flowers, borne in few-flowered axillary racemes, are cream-colored and 5–6 cm. long. The fruit is unusual and rather suggestive of a large watch. It is smooth, biconvex, and orbicular or broadly elliptical in lateral outline, and measures 6–8 cm. broad, 8–11 cm. long, and 1.5–2 cm. thick. At maturity the broad polished sides of the fruit fall away, freeing many broad, flat, papery-margined seeds and leaving a thin, pale, skeletal ring of fibers to hang for some time on the vine. The species is known only from Panama and northern Colombia. (Fl. C. Z. p. 339). *Johnston 198, 469, 668, 714; Erlanson 14, 34, 391; Harlow 40; Andersson.*

Arrabidaea Chica (H. & B.) Verl.

A slender woody vine frequent in thickets along the western side of San Jose and occasional in open forest on the northern part of the island. The opposite compound leaves usually have three glossy leaflets, but on vigorous shoots may have the middle leaflet replaced by a simple tendril. The leaflets are lanceolate to broadly lanceolate, 7–12 cm. long and 2.5–6 cm. broad, and are rounded or obtuse at the base and acute or acuminate at the apex. A distinctive feature of this plant and a great aid in identifying it are the color changes of its foliage. Old leaves, before being shed naturally, as well as dying leaves on cut stems, all turn a brilliant crimson before falling to the ground. This produces some magnificent splashes of color for a week or so, when large stems of the vines are cut during clearing operations. Usually, however, the color is manifest only by an occasional leaf giving a red accent here and there in the handsome prevailingly dark green glossy foliage of the plant. The rose or magenta flowers, about 3 cm. long, are produced in branched terminal inflorescences. They appear during the latter half of the wet season. The elongate, strap-shaped pod was not seen on the island. The species is found in Central America and northern South America. *Johnston 14; Harlow 28.*

Arrabidaea pachycalyx Sprague

A woody vine climbing trees in open forests on the northern half of the island, where it is widely scattered but not common. It was observed here and there in limited numbers east of Red Hill, near the Air Strip, along the eastern and northern sections of the Loop, and on Dead End Road. A plant available for close study grows in a very low tree at the junction of the Loop and Canyon Road. On the southern half of the island it was seen only along the road back from Englishman Beach.

The opposite compound leaves usually have three leaflets, but on vigorous shoots have the middle leaflet replaced by a simple tendril. The oblong to ovate leaflets are 8–12 cm. long and 4–8 cm. broad, and are somewhat truncate or obscurely cordate at the base. Their coloration is distinctive. They are green above but white from a thin coating of hairs beneath and become somewhat pinkish or reddish when dying. The loosely branched terminal inflorescence, 5–10 dm. long, bears great numbers of pink flowers. Produced in great numbers and thrust out from the vine, they make a beautiful display in the treetops during January. The flat, strap-shaped pods, 3 dm. long and 11 mm. broad, are matured in late February.

The species is known from British Honduras, Costa Rica, Panama, and Colombia. It is certainly distinct from *A. candicans* (Rich.) DC., with which it has been identified. It differs in its larger flowers and in the color and pubescence of its broader leaves. The leaves are granular-puberulent rather than glabrous above, and have a grayish (not pure white) coating of coarser hairs beneath. (Fl. C. Z. p. 340). *Johnston 969, 1324, 1407.*

Callichlamys latifolia (Rich.) Schum.

A woody vine which occasionally grows over thicket but usually climbs high in trees. It was found in abundance at only one place, just north of the Garbage Dump, where it grows over a large area of thicket and climbs many emergent trees. Here it puts on quite a display when in full flower. It is an occasional plant in the forest near Camp, being noticed back from Englishman Beach, along the Cut Off, near the Supply Office and on the giant trees at the very head of Camp Valley. Elsewhere it is known only from a few vines seen growing on scattered trees in open forest along the northern part of the East Loop.

The opposite compound leaves have three leaflets or, on vigorous shoots, two leaflets and an interposed simple tendril. The leaflets are broadly lanceolate to elliptic, 8–18 cm. long and 4–11 cm. broad, and have an obtuse to rounded base and an acute or obtuse slenderly acuminate apex. The coarse flowers are borne in small clusters along the leafy stems, or are at times terminal on leafy shoots, or are found along woody stems devoid of leaves. They are 7–10 cm. long and very conspicuous with their yellow funnelform corolla and a coarse sack-like calyx of a darker shade of yellow. Flowering plants were observed between the last of December and late March. In addition to some scanty sporadic blooming, the plant had two short periods of prolific and general flowering during my last trip to the island. On January 17 and again on February 20 individuals on the Loop, several of those near Camp, and a great number near the Garbage Dump all came into abundant flower the same day and remained conspicuous for about a week. The large woody pods of this species (elliptic in lateral outline, biconvex in cross section, 2–3 dm. long and 6–8 cm. broad) were searched for but not found. In fact, so far as could be determined, the plant set no fruit at all. At the end of January, ten days after profuse flowering, many vines near the Garbage Dump were examined rather thoroughly. Every flower had fallen, apparently not one of them having set fruit. The species is found in Central America and tropical South America. (Fl. C. Z. p. 339). *Johnston 508, 1161, 1169.*

Cydista aequinoctialis (L.) Miers

A woody vine collected in the thickets in Area 11A by Erlanson. The opposite compound leaves have three leaflets or two leaflets and an interposed simple tendril. The lustrous leaflets, 8–15 cm. long and 3–7 cm. broad, are obtuse or rounded at the base and coarsely shortly acuminate at the tip. The flowers, 6–7 cm. long, are borne in clusters at the end of leafy branches. They were found by Erlanson in mid-July and reported to be white with a pink stripe in the throat. The strap-shaped fruit was not seen. The species ranges from Mexico and Cuba south to Colombia and Amazonian Brazil. (Fl. C. Z. p. 339). *Erlanson 485.*

CRESCENTIA CUJETE L. CALABASH

An old tree, almost certainly planted, grows with a mango and some bananas on the terrace at Mango Beach, probably marking the site of a former dwelling, perhaps that of pearl divers. The oblanceolate leaves, 5–15 cm. long, grow crowded in clusters along the branches. The fruit is globose, hard-shelled, gourd-like, and 1–2 dm. in diameter. The species is widely distributed in tropical America. (Fl. C. Z. p. 340).

Cydista heterophylla Seibert

A woody vine growing abundantly in deciduous woods back of the sea cliffs near the Lookout at East Harbor. It was seen nowhere else on the island. The opposite compound leaves have only two leaflets, or on vigorous shoots, two leaflets and an interposed simple tendril. Occasional leaves have only a single leaflet developed. The elliptic leaflets, 7–15 cm. long and 4–8 cm. broad, are green above and rather pale beneath and have a rounded base and a short, coarse acumination at the tip. During the latter part of February the plant sheds all its foliage and remains naked until after flowering late in April. The flowers are pink or orchid, 5–7 cm. long, and borne bountifully in clusters along the slender stems. These lovely flowers, borne along leafless stems in incredible numbers, and held aloft by nearly leafless trees, make one of the most beautiful floral displays to be seen on the island. The species is known only from northeastern Central America and adjacent Mexico and from the Perlas Islands. *Johnston 812, 831; Erlanson 38.*

Enallagma latifolia (Mill.) Small

A shrub or small tree 2–6 m. tall, frequent along the south side of Bodega Bay and at E. M. Beach, where it grows about the margins of mangrove swamps and on the back part of beaches and on sheltered slopes just behind them. On Punta del Cabo it grows on steep seaward slopes and, sparingly, even on the windy crest of the high outer headland.

The thickish lustrous leaves, 1–2 dm. long and 5–10 cm. wide, are broadest at or above the middle. They are rounded or obtuse at the apex and acute to obtuse at the base. The petiole is 3–10 mm. long. The coarse flowers are produced 1–2 together from the axils of older leaves or more commonly from the old wood along leafless branches. They are held out horizontally on pedicels 4–6 cm. long. The coarse calyx, 2.5–4 cm. long, is light green spotted with small, very irregularly dispersed bright green tuberculations. Splitting laterally, commonly to the base on one side and only to about the middle on the other, it becomes about equally divided into a coarse dorsal

and a ventral lobe. The coarse, gaping, rather oblique corolla, about 5 cm. long, is greenish or yellowish, more or less stained with purplish or reddish, particularly on its upper side. It has no spreading limb and is only very weakly lobed, but has a slightly revolute outer margin. The lower lip is notched at the middle, and in the open throat behind it there is a pronounced rounded transverse fold 3–4 mm. wide and nearly as high. The hard-shelled globose fruit, 6–8 cm. in diameter, is gourd-like and filled with many seeds packed in a slimy pulp with a pleasing, very fruity odor. They are to be found hanging on the plant at most seasons but apparently in greatest abundance during the latter part of the rainy season. They are well adapted for transportation by water and are frequently found stranded in the drift on the beaches of Bodega Bay. The species grows along coasts from Florida and southern Mexico south to Venezuela. (Fl. C. Z. p. 341, sub *E. cucurbitina*). *Johnston 10, 1179; Erlanson 4; Harlow 97.*

Jacaranda Copaia (Aubl.) Don.

A tree 15–25 m. tall, widely but erratically scattered in the forests of the island. It is an uncommon plant but one that attracts attention when it comes into flower in March and April. A dozen or more individuals were noted near the Loop, just east of its junction with Dead End Road, but elsewhere the trees usually grow singly and apparently widely separated from others of their kind.

The open crown is 6–10 m. broad and disproportionately small for the size of the tree. It is held aloft by a handsome straight gray trunk 2–4 dm. thick that frequently rises 10–20 m. before branching. The opposite bicompound leaves are large and fern-like. Their main rhachis is 4–7 dm. long and bears about 7 pairs of opposite secondary rhachises 1–2 dm. long, each bearing 10–20 mostly opposite leaflets. The distinctly asymmetric leaflets, 3–7 cm. long and 1–2 cm. wide, are broadest above the middle. They are paler beneath and narrowed towards both ends. The foliage is renewed during late January and in February. Flowering occurs in March and April, when the tree produces many large branched inflorescences bearing great numbers of blue flowers 3–4 cm. long. For a week or so the tree is beautiful and very conspicuous, and, as the only blue-flowered tree on the island, may be recognized even in forests on distant hillsides. Very immature fruit was collected in April. The flattened ellipsoidal pod, 8–15 cm. long and 5–9 cm. broad, probably matures about the beginning of the rainy season. The species ranges in Central America and northern South America. (Fl. C. Z. p. 341). *Johnston 635.*

Macfadyena uncata (Andr.) Sprague & Sandw.

This plant, usually a high climbing woody vine in forests, is known on San Jose only through juvenile forms. These latter are common in the shade of the undisturbed forest at Englishman Beach, and by January 1946 had appeared in large numbers beside the road through the forest a little further inland. The seeds of this species are poorly protected and not fitted for extended periods of dormancy in the soil. The presence of juvenile plants near Englishman Beach and the recent appearance of others near by, along a road made in 1944, would indicate a local source of seed. Though a determined search was made, not a single individual of the high climbing, abundantly

flowering mature form of the species could be located. This is surprising, for this mature plant is easily recognizable. It grows over the tops and sides of forests and has opposite compound leaves which bear two lanceolate leaflets 6–15 cm. long and 2–6 cm. broad, and commonly also an interposed tendril terminated by three sharp claw-like branches. Its flowers are yellow, 5–7 cm. long, and its flattened elongate pod becomes as much as 25 cm. long and 2 cm. broad. With this mature form of the species apparently absent, the great numbers of juvenile plants at Englishman Beach is hard to explain.

The juvenile plants at Englishman Beach grow only in forest shade. Their roots are widely spreading but shallow, and some of them are always swollen and serve as underground storage organs. Many of the young plants grow where there is no object close by that might be climbed. These develop a slender, somewhat fruticulose, erect, usually unbranched stem 1–3 dm. tall, and bear several pairs of simple opposite leaves. The leaves show very great variation in size and form from plant to plant. They are ovate, elliptic, or narrowly lanceolate, 5–18 cm. long and 2.5–9 cm. broad, and have petioles 1–5 cm. long. Most of them are somewhat cordate at the base. Their lower surface is beautifully purple and somewhat lustrous, while their upper surface is dull dark green and attractively mottled with silvery gray along the principal veins. The foliage is very ornamental and distinctive. It is, however, confined only to this small erect form of the species.

The form of the species with erect, unbranched stems and simple leaves may be very young plants, as those observed on the roadside, or quite old ones arrested in development and remaining simple in form because no support for climbing branches has been available. When it happens, sooner or later, that one of these simple erect plants touches a support, a trunk, a fallen branch, a large vine stem, or even a large rock, it then changes profoundly and abruptly in its manner of growth and in the size and structure of its leaves. The stems become wiry and lengthen rapidly. The plant, with stems and foliage flattened against its support, as if glued to it, begins to creep upward. The leaves on these stems have sober coloration and are of entirely new form. They are opposite and compound, each consisting of two small lanceolate leaflets 1–4 cm. long and 3–14 mm. broad, and an interposed set of three sharp, curved, clawlike tendrils 3–5 mm. long. Usually the short petioles, 3–7 mm. long, are sharply deflexed. They are straight or become up-curving near their middle and display the usually outwardly and downwardly directed leaflets well below the level of the stem node at which they originate. The claw tendrils, hooked into the supporting surface, do not support the stem but merely anchor the leaves in position. Innumerable tiny roots, produced laterally just below each leaf, tie the stems to the substratum.

The stems of the creeping form are very slender and rarely more than 2 mm. thick. Commonly they ascend to only a few meters above the ground. A few were seen nearly 6 m. up a tree, but these were exceptional. It might be imagined that the plants would eventually creep up into the top of the forest, and there, with plenty of sunlight available, begin to grow luxuriantly and develop their mature form. As far as could be determined, however, they showed no inclination to do so. Many of the plants with creeping stems become much branched and have numerous stems decorating the basal few meters of the tree trunks. Apparently they find it entirely congenial inside

the shady forest. These facts, taken in conjunction with the apparent total lack of the so-called mature plants in the vicinity, suggest that possibly these well-developed creeping plants may not be immature phases, but rather a mature shade form of the species which happens to retain some juvenile characteristics. Though examined repeatedly they were never found with flower or fruit nor with any evidence of having ever produced them. Possibly, however, they may flower and fruit during a period when they have not been under observation. If they actually do so, then a source of seed would be available, and the large number of young plants growing near Englishman Beach would be understandable. The species is known from Mexico, Central America, the southern West Indies, and tropical South America. (Fl. C. Z. p. 338, sub *M. uncinata*). *Johnston 794.*

Martinella obovata (HBK.) Bur. & Schum.

A woody vine which grows over thickets at the north end of the island. It is frequent along the outer portion of Bald Hill Road, and in January 1946 had become very common in the thickets in Area 11A which were then regenerating after having been burnt over the previous April. I saw the plant only at the north end of the island. Erlanson, however, found it also in Area 7A, growing high in trees.

The plant has rather slender stems and is loosely branched. The opposite compound leaves usually bear two leaflets and an interposed tendril trifurcate at its tip. The ovate to lanceolate leaflets, 7–18 cm. long and 4–12 cm. broad, are pale beneath and rounded or somewhat cordate at their base. The flowers are borne in very loose axillary racemes 5–15 cm. long, or rarely solitary in the leaf axils. The very dark purple corolla is 5.5–7 cm. long. The strap-shaped pod becomes as much as 15 cm. broad and 9 dm. long. The plant flowers after mid-April and during May and matures its fruit about July. Its forked tendrils and loose racemes of dark flowers aid in identifying it. The species is known from Central America and tropical South America. *Johnston 771; Erlanson 97, 338.*

Phryganocydia corymbosa (Vent.) Bur.

A woody vine common in the thickets and forests on the northern and western parts of the island. It flowers, at least in limited amounts, all months of the year, but puts on its greatest show during the rainy season when it blooms in great profusion after each rainy spell and decorates, from time to time, isolated trees, sections of forest margin, and areas of thickets, with innumerable lovely pink flowers. It is common and a very conspicuous plant when in flower. On San Jose it is usually called "morning-glory," a name to which it has no claim.

The opposite compound leaves usually bear two leaflets, but on vigorous shoots two leaflets and an interposed simple tendril. The lustrous, lanceolate to ovate leaflets 7–15 cm. long 3–9 cm. broad have an acute to rounded base and an acute or somewhat acuminate apex. The flowers are borne in loose clusters along or at the ends of the branches. The funnelform pink or lilac corolla is 6–7 cm. long. The calyx is distinctive, being unlobed, oblique, and split down one side. The fruit is a flat strap-shaped pod 1.5–2 cm. broad and 3–5 dm. long. It is generally hidden among the foliage and usually not very abundant. Only occasionally is one to be seen dangling from some high

branch. Great numbers of pods were seen on only one vine, this smothering a nearly dead tree near the road back of Englishman Beach. During January 1946 the pods on this vine were so very numerous that they became conspicuous, fully 2000 of them, it was estimated, being exposed to view. The species is known from Panama, Trinidad and tropical South America. (Fl. C. Z. p. 339). *Johnston 164, 317, 1263; Erlanson 9; Harlow 4, 30.*

Pleonotoma variabile (Jacq.) Miers

A woody vine with distinctive stem and leaves which was noted at three widely separated places on the island. A plant was found in the forest between Areas 3C and 3D, another in dry forest not far from East Road between Areas 8A and 8B, and a third climbing in the forests along the Marino at the east end of Volmer Lane in Area 7A. Only three plants were seen, the largest being that in Area 7A.

Twigs and stems, at least up to 1 cm. thick, are decidedly 4-sided and sharply 4-angled. The angles are formed by strips of hard brown tissue and in young twigs are easily detached from the softer green mass of the shoot. Old stems, 4 cm. thick, are not angled, but when cut reveal 4 broad triangular wedges of phloem penetrating into the wood. Unlike the other viny members of this family on San Jose, the plant has the opposite leaves bicompound. The leaf has two groups of three leaflets, and frequently an interposed trifurcate tendril. The six leaflets, 6–12 cm. long and 3–8 cm. broad, are ovate to lance-oblong, and the lateral ones are oblique at the base. When discovered in February 1946 the plants were in a period of vigorous growth but devoid of flowers or fruit. Judging from the behavior of the species on the mainland, the yellow or white flowers probably appear in March or April. The fruit is a strap-shaped pod 2–3 dm. long. The species is found in Costa Rica, Panama, and northern South America. *Johnston 1346, 1400, 1412.*

Pseudocalymma macrocarpum (Donn. Sm.) Sandw.

A woody vine climbing over the tops of the large trees on the bank at the rear of the swamp at Main Beach and over one of the giant figs along the Cut Off. It was not seen elsewhere on the island. The bruised and wilting herbage of the plant has a permeating, very pronounced garlic-like odor, remarkably like that of Mustard Gas. The opposite compound leaves bear two leaflets, and at times two leaflets and a trifurcate tendril. The light green, ovate to very broadly ovate leaflets, 6–10 cm. long and 4–8 cm. broad, are rounded or obscurely cordate at the base and coarsely short-acuminate at the tip. The lilac or violet-pink flowers, 5–6 cm. long, are borne in loose clusters along the stem shortly after leaf renewal. During 1946 the plant came into general flower the first of February and again on the 20th, and was conspicuous for nearly a week each time. The species ranges from Mexico to Panama. *Johnston 1342.*

Tabebuia palustris Hemsl.

A loosely branched shrub or small tree 2–4 m. tall which grows in the shaded places in the drier marginal parts of the mangrove swamps at Long Beach, Main Beach, and Playa Grande. It is an unobtrusive plant and not very common. The compound opposite leaves bear three leaflets. The leaflets, 12–30 cm. long and 1.5–6 cm. wide, are broadest at or below the middle and

taper towards the acute ends. The flowers are borne one or two together, scattered along the usually leafy branches, and have a white corolla 5–7 cm. long, with two yellow lines in the throat. The stout biconvex fruit is a capsule packed with flat seeds and is about 8–9 cm. long, 22 mm. broad, and 10–12 mm. thick. It is abruptly contracted into a stipe at the base and into a slender beak at the apex. Flowering begins with leaf renewal in April and continues through the rainy season. The species is known only from Panama. (Fl. C. Z. p. 343). *Johnston 2, 798; Erlanson 224, 330; Harlow 59.*

Tabebuia pentaphylla (L.) Hemsl. ROBLE

A tree 10–15 m. tall occurring as scattered individuals standing in thicket and practically always within sight of the ocean. It is most abundant in the southwestern parts of the island, where, happily, many grow within sight of Camp. The tree sheds its leaves during January and February and generally during March, when, completely bare of foliage, it produces clusters of pink flowers in such incredible profusion that its crown is transformed into one great mass of color. When in flower the plant properly attracts much attention, for it is then magnificent and a thing of exceptional beauty.

The leaves are opposite and digitately compound. They commonly bear five leaflets, mostly 1–1.5 dm. long. The pink funnelform corollas are 6-8.5 cm. long. The fruit is a slender elongate pod about 3 dm. long and 12 mm. thick, which is beaked at the apex and contracted into a stipe at the base.

Near the coast, and particularly near Camp, young trees appeared and grew rapidly in second growth. In less than two years some reached 4.5 m. high and developed trunks up to 9 cm. in diameter. In January 1946 seedlings of this *Tabebuia* were rapidly becoming the dominant new growth on a small clearing near the road to the Garbage Dump, where old lumber had been burnt about a year before. The species ranges from Mexico and the West Indies south to Venezuela. (Fl. C. Z. p. 343). *Johnston 519.*

Tecoma stans (L.) Juss.

A bushy shrub 3–4 m. tall. It is frequent in the thickety growth at the head of sandy beaches and in less abundance is found on and about sea cliffs and on thin soil about rock outcrops on slopes and ridges. It is locally very common in the clearing at the Navy Station. The leaves are opposite and pinnately compound. Their 3–7 leaflets, borne oppositely along the rhachis, are lanceolate, 5–12 cm. long and 1.5–3.5 cm. broad, and have acute ends and a sharply toothed margin. The conspicuous bright yellow flowers are borne in terminal racemes. The fruit is a slender pendent pod 1.5–2 dm. long. The plant flowers and fruits repeatedly during the dry season but soon gets very unkempt in appearance because of the large numbers of persisting weathered parts of old pods accumulated on its branches. The species is widely distributed in the American tropics. (Fl. C. Z. p. 342). *Johnston 574; Erlanson 75, 126; Harlow 93.*

GESNERIACEAE

Codonanthe decurrens Johnston, nom. nov.

A species growing only on the globular earthen ant nests found on the branches of trees. It is usually present on these nests and is widely dis-

tributed in the forested parts of the island. It produces numerous erect or ascending, commonly unbranched stems, usually 2–4 dm. long. They are clothed with fleshy, opposite oblanceolate leaves 4–7 cm. long which gradually contract towards the base into a slender petiole 5–10 mm. long. The flowers, borne singly in the upper leaf axils, are about 4 cm. long. They appear late in the rainy season. They are spurred at the base and in color are white, with pink streaks in the throat. The fruit is subglobose, purplish, and 10–12 mm. in diameter.

The species is known from southern Mexico (Oaxaca, *Martinez-Calderon 140*, and Tabasco, *Matuda 3381*), British Honduras (*Gentle 3583*), and eastern Guatemala (*Tuerckheim 7645*, TYPE), and has been confused with the more widely ranging Central American plant *C. crassifolia* (Focke) Morton. It has been described as *Columnea calcarata* Donn. Sm. (1902), but that name cannot be transferred to *Codonanthe*, since the resulting binomial has already been applied to a Guianan species *C. calcarata* Hanst. (1865). In our plant, on the lower surface of each sepal, and especially on the lowest one, there is a prominent keel that is prolonged downward and is decurrent for some distance on the pedicel, becoming especially prominent just beneath the calyx. In this character the species is distinct from all other members of the genus. From *C. crassifolia*, the other species of the genus found in Central America, our plant further differs in its much larger corollas and erect, non-repent stems. *Johnston 425, 456.*

Diastema exiguum Morton

A small herb growing on wet, shaded, mossy rocks and cliffs in the vicinity of Red Hill. It grows 2–10 cm. tall and has a tubular white corolla 16–20 mm. long. The plant grows and flowers in the wet season and dries up and disappears early in the rainless period. In October 1944 I found it in full bloom with myriads of its white flowers decorating the shaded, seepage-wet, mossy ledges and cliffs on the precipitous forested slope that drops from the upper part of Red Hill Grade into the North Fork of the Marino. The species is known only from Costa Rica and Panama. *Johnston 128; Erlanson 542.*

Drymonia spectabilis (HBK.) Mart. ex G. Don

A vine climbing in trees on the coastal cliffs near Main Beach and trailing through thicket near the shore end of Canyon Road and on seaward slopes at the western corner of Area 11A. The juicy stems have a papery reddish bark. The opposite, somewhat asymmetric, slightly fleshy leaves, 8–20 cm. long and 2.5–7 cm. broad, are more or less toothed on the margin. They are dark green, obscurely and sparsely pubescent above, and pale beneath. The petiole is 8–30 mm. long. The corolla is very irregular, about 5 cm. long, and has lobes with toothed margins. It is at first white or pinkish, but changes to dark red in age and is partially obscured by the coarse calyx made up of broad foliaceous dentate lobes. The fruit is a capsule sheathed by the large calyx. At maturity, late in the wet season, it splits in half and spreads, revealing its dark red glutinous interior surfaces. In this state it becomes more attractive than the flowers. The species apparently ranges from Mexico to Colombia. (Fl. C. Z. p. 346). *Johnston 62, 1058; Harlow 53.*

Kohleria tubiflora (Cav.) Hanst.

A juicy herb growing on thin soil on cliffs and on rocks along the coast. It is one of the characteristic plants growing on the barren islets and exposed tops of large rocks along the shore, where it usually associates with *Brassavola* and *Cereus*. The plant is usually erect, 6–18 cm. tall, and has commonly reddish, unbranched stems. The thickish pubescent opposite leaves are 5–10 cm. long and 2.5–5 cm. broad. The red, hairy, tubular corollas are 2–3 cm. long and suggestive of small firecrackers. They are produced after the middle of the wet season and continue to appear as late as December. The species is known only from Costa Rica and Panama. (Fl. C. Z. p. 344). *Johnston 125, 171, 926; Harlow 54.*

Tussacia Friedrichsthaliana Hanst.

A juicy herb commonly growing in colonies and forming low, dense, leafy masses in partially exposed places, usually about the base of large bouldery masses of rock. The plants appear at the beginning of the wet season and are in flower during all the rainy months. By the middle of December they are largely dried up and have disappeared. They were seen near the Cross Roads, on Goat Hill, near Camp, and on Max Point. The stems are usually less than 15 cm. tall and bear 3–6 pairs of light green oblanceolate leaves 10–30 cm. long and 2–8 cm. broad. The leaf blade is acute at the apex and from above the middle is gradually tapered towards the base and lacks a distinct petiole. The margin is toothed. The attractive cluster of flowers is elevated only slightly above the dense mass of its herbage. The corolla is orange with dark red lines in the throat. It is about 2 cm. long, has a flaring limb about 15 mm. in diameter, and protrudes from a coarse calyx. The species is known from Guatemala, Costa Rica, and Panama. (Fl. C. Z. p. 344). *Johnston 141; Erlanson 493, 574; Harlow 34.*

ACANTHACEAE

Blechum pyramidatum (Lam.) Urban

A decumbent, opposite-leaved herb that bears its small lavender flowers in a coarsely bracted, somewhat cone-like four-sided terminal inflorescence. The plant is obviously a recent introduction from the Isthmus. It was a well-established weed about the Navy Station in November 1944. In December 1945 it was a common weed in the lawn at Camp and was growing in limited numbers with other introduced weeds on the fill along Red Hill Grade. The species is widely distributed in the tropics. (Fl. C. Z. p. 349). *Johnston 895, 1318.*

Elytraria imbricata (Vahl) Pers.

A slender herb with small blue flowers borne in dense erect catkin-like spikes. It is occasional on areas of thin soil on the eastern peninsula. The species ranges from Mexico to northern South America. (Fl. C. Z. p. 350, sub *Tubiflora squamosa*). *Johnston 543; Erlanson 253.*

Justicia comata (L.) Lam.

An herb occasional as a weed in the lawn at Main Camp. It was obviously introduced from the Isthmus and was first collected in January 1946.

The plant is widely distributed in tropical America and usually grows in damp places. (Fl. C. Z. p. 351). *Johnston 1008.*

JUSTICIA PECTORALIS Jacq.

A few flowering plants of this species were collected with the previous species in the lawn at Main Camp. It was first discovered in January 1946 and is evidently an introduction from the Isthmus. The species is widely distributed in tropical America. (Fl. C. Z. p. 351). *Johnston 1008a.*

NELSONIA BRUNELLOIDES (Lam.) Kuntze

A perennial herb clothed in soft slender pallid hairs which was discovered abundantly established in the lawn about the chapel at Main Camp in January 1946.

The plant is widely distributed in tropical regions and usually grows in wet places. (Fl. C. Z. p. 350). *Johnston 1200.*

Trichanthera gigantea (H. & B.) Nees

A tree 5–10 m. tall, found in very limited numbers along the stream in the dense shady bottom-land forest just east of the E. M. Barracks near Camp and in the streamside forest in Area 11B. It was just coming into full flower when discovered in April 1945. The plant is readily distinguished by its large, opposite, distinctly heteromorphic leaves. The leaves, 10–25 cm. long and 6–15 cm. broad, are elliptic or elliptic-oblong and more or less asymmetric, and are acute at the base and obtuse and short acuminate at the tip. They are green and glabrous above and below are paler and bear scattered hairs along the midrib and veins. The opposing leaves at each node of the stem differ in size and in the length of their petioles. The larger leaf has 1.5–2.5 times the length of the smaller leaf and has a slender petiole (5–10 cm. long) which is usually 4–6 (or rarely 8) times as long as that on the opposing smaller leaf. The flowers are produced in large numbers in a terminal stiff pyramidal inflorescence. The conspicuous corollas, nearly 4 cm. long, have a stout tube, flaring throat and lobes, and conspicuously exserted stamens bearing bearded anthers. Inside, the corolla is reddish; outside it is densely coated with pale appressed hairs. The elliptic or oblong sepals are about 12 mm. long.

The island plant represents the variety *guianensis* Gleason, which is known only from low altitudes in Costa Rica, Panama, Venezuela, and the Guianas. It differs from the typical form of the species, found at moderate altitudes in Colombia, in having filaments hairy throughout, and in having leaves that are not only much more pronouncedly heteromorphic, but also thinner in texture. (Fl. C. Z. p. 349). *Johnston 679.*

PLANTAGINACEAE

PLANTAGO MAJOR L.

A few flowering and fruiting plants of this widely distributed weed were found about the Goat Barn in January 1946. The plant was probably introduced in unclean hay shipped from the United States. The plant is a native of the Old World but is now naturalized in many parts of the world. *Johnston 1231.*

RUBIACEAE

Alibertia edulis Rich.

A shrub or small tree, usually 1–3 m. but rarely up to 6 m. tall, which is frequent here and there in moderately open forests and about forest margins within a half-mile of the coast. Near the shore it was observed on various types of substrata from rich bottom land to rather poor soil. In the interior of the island, however, the plant is not only less common but also tends to favor sites about the margin of areas of thin soil.

The opposite lustrous dark green lanceolate leaves are 10–20 dm. long and 2–5 cm. broad, with those along each twig all of about equal size. The petioles are 3–7 mm. long. The stipules, 5–15 mm. long, are subulate-attenuate from a broad base. The sessile unisexual flowers are 2–2.5 cm. long, white and fragrant, and have a limb of five attenuate lobes 2 cm. in diameter. The female flowers are solitary while the male ones are borne, several crowded together, at the end of the leafy elongate twigs. The distinctive smooth globose fruit, about 2 cm. in diameter, is green or greenish yellow when mature and is permanently crowned by the tough collar-like tube of the persistent calyx. It is produced at the very end of the elongate leafy twigs and is always subtended by a pair of large leaves. It consists of a tough, thin shell which surrounds a dense crowded mass of seeds. Despite reports in books it is certainly not to be classed as an edible fruit. The plant flowers during the first half of the rainy season and bears its fruit from October until as late as February. The species is widely distributed in tropical America. (Fl. C. Z. p. 358). *Johnston 46; Erlanson 273, 378, 563.*

Amaioua corymbosa HBK.

An understory tree common in the forests of the island. It grows 4–12 m. tall and usually has a trunk 1.5–2.5 dm. thick. The opposite, usually elliptic leaves are dark green above and beneath paler and very prominently veined. They are 7–15 cm. long and 3–8 cm. broad and have a petiole 8–20 mm. long. The twigs are usually forking, frequently falcately curving, and usually have some very elongate internodes. The inflorescence consists of slenderly stalked umbels, borne several together on short stout leafy twigs that cease to elongate and are soon overtopped by the incurving elongate branchlets developed below them. The umbels are 3–9-flowered and commonly have peduncles 1–3 cm. long. They bear male or female flowers, apparently during the early part of the wet season. The male flowers are white and fragrant and have a silky tube 8–10 mm. long and a limb of 6 narrow spreading lobes 10–18 mm. in diameter. The ellipsoidal, slightly juicy fruit is 10–15 mm. long and is borne clustered at the ends of the peduncles. Produced in large numbers they mature slowly and are noticeable on the trees from August to May, at first being brown, but eventually becoming bluish or purplish black when fully ripe. They have a smooth, somewhat lustrous tough outer skin and contain numerous small seeds. The species is known from Cuba, Mexico, British Honduras, Panama, Trinidad, and in eastern Venezuela and adjacent Guianas and Brazil. (Fl. C. Z. p. 357). *Johnston 17, 201, 639; Erlanson 90, 178, 398, 551; Harlow 13.*

Borreria densiflora DC.

A stiffly erect, opposite-leaved, annual herb 3–12 dm. tall, growing on islets and rocks along the shore of Hicaco Island and on areas of thin soil above the sea cliffs at East Harbor and the Navy Station. The species is known from Nicaragua, Panama, Colombia, Venezuela, Tobago, Guadeloupe, Martinique, and Jamaica. (Fl. C. Z. p. 364, sub. *B. spinosa*). *Johnston 822, 837, 838, 930, 1084.*

Borreria latifolia (Aubl.) Schum.

An herb found on disturbed soil on Bald Hill grassland, on rocks along the coast of Hicaco Island, and at the head of sea cliffs at East Harbor, the Navy Station, and Camp. The plant from Hicaco Island grew erect, but the other collections are all prostrate. The plants from Bald Hill and East Harbor are noticeably more or less hispid-villous on the stem and on the leaf surfaces. The other collections are inconspicuously pubescent. The plants at the Navy Station and at Camp conceivably could be some introduced from the mainland, but, although they were associating with weeds, they were found close to the summits of sea cliffs along which the species grows and might have spread from them. The species is widely distributed in the American tropics. (Fl. C. Z. p. 364). *Johnston 434, 834, 929, 989, 1085.*

Borreria ocymoides (Burm.) DC.

A weak, spreading, opposite-leaved herb occasional in sunny open places where the soil is thin. It was found at the head of sea cliffs at Camp, near the Engineer Camp, and at East Harbor, about rocks on the ridge at Max Point, and on various scattered areas of thin soil along the eastern side of the island.

The species ranges from Mexico and Jamaica into South America and is also known from the Old World tropics. The type came from Java, where it was probably introduced from America. In America the species has been usually confused with *B. parviflora* Mey., and frequently not distinguished from it. The distinctive characters of the present species are its weak herbaceous, usually prostrate stems, broad obovate leaves, smaller glabrous papery mature fruit, two sepals, and seeds marked with rows of fine ridges and grooves. It is not a common plant in America and seems to be confined to low altitudes. (Fl. C. Z. p. 364). *Johnston 214, 320, 902, 989A, 1066; Erlanson 318, 452.*

Borreria parviflora Meyer

A slender herb growing in the grassland at Bald Hill and on thin soil topping bluffs near South Beach. The species ranges widely in tropical America, extending from Mexico and Florida south to Bolivia and Brazil. In the past it has been confused with *B. ocymoides* but is readily distinguished by its more wiry stems, usually narrow leaves, larger, tougher, usually hairy fruits, 4-lobed calyx, and coarsely alveolate seeds. It is very much more common than the species confused with it. In fact, most American specimens labeled "*B. ocymoides*" actually belong to this well-marked but neglected species. *Johnston 36, 43, 879; Erlanson 530, 572.*

Borreria pumilio Standley

A diminutive, slender-stemmed annual, abundant about the highest point in the grassland at Bald Hill. The species is otherwise known only from a single collection made in Cocle, Panama. *Johnston 42.*

Chiococca alba (L.) Hitchc. LÁGRIMAS

A slender-stemmed shrub clambering in high thickets and climbing high on forest margins in all parts of the island. The main stems, 2–5 cm. thick, are usually more or less evidently four-sided. The opposite lustrous dark green leaves are lanceolate to ovate or nearly elliptic and are 4–10 cm. long and 1.5–5.5 cm. broad. The petioles are 6 mm. long or less. The persistent stipules are about 2 mm. long and are subulate with a broad base. The flowers, produced in greatest abundance during the rainy season, are borne in axillary simple or branched racemes 1–8 cm. long. Their corolla, about 7 mm. long, has acute, usually recurved lobes and is at first white, but may become cream-colored in age or even somewhat pinkish where exposed to strong sunlight. The fruit is distinctive. It is a snowy white berry, strongly flattened laterally, circular in lateral outline, and about 6 or 7 mm. in diameter. Matured in great numbers, these snowy white berries may become very conspicuous and decorative elements on the forest margins during the latter part of the wet season. The species is widely distributed in tropical America. (Fl. C. Z. p. 360). *Johnston 55; Erlanson 24, 341, 370, 397, 484; Harlow 6, 8.*

Genipa americana L. JAGUA

A small tree, 2.5–6 m. tall, locally numerous in the thickety growth margining the grassy open places on the area of thin soil back of the sea cliffs at East Harbor. The twigs are coarse and brittle. The large opposite obovate leaves, 1.5–5 dm. long and 8–25 cm. broad, are glabrous and lustrous above and paler, duller, and minutely hairy on the lower surface. The petiole is 5–10 mm. long. The stipules are triangular, 5–8 mm. long, and deciduous. When first discovered, early in February 1946, the trees were shedding their foliage. The old leaves turned bright yellow before falling. The plants, accordingly, were conspicuous because of their gay foliage or because of the great numbers of large yellow leaves accumulating on the ground about them. Leaf renewal followed promptly, most of the trees remaining naked less than a fortnight. The coarse white flowers, borne in small cymes, probably appear at the beginning of the wet season. The fruit is borne singly, terminal on stout twigs, and is gray and roughened by abundant scattered protrudent lenticels. According to the books it may become 7 cm. in diameter. That seen maturing at East Harbor, however, measured 3.5 cm. in diameter and 4 cm. long. It had leathery walls and contained two cells full of pulp and seeds.

The species is widely distributed in tropical America. Our plant is the form with pubescent foliage distinguishable as the variety *Caruto* (HBK.) Schum. (Fl. C. Z. p. 357). *Johnston 1358.*

Geophila repens (L.), comb. nov.

A creeping herb carpeting the ground, sometimes over several square meters, in shaded, usually damp places in forests. It is not a common plant and was seen only at scattered places in Camp Valley, in Area 7A, in Area 8B, near Canyon Road, and in Area 11B. It flowers and fruits during the rainy season.

The opposite heart-shaped leaves, 2–3 cm. long, are borne on petioles up to 7 cm. long that spring from along the very slender creeping stems. The flower is white, trumpet-shaped, and nearly 1 cm. long. The fruit is a red berry.

The species is widely distributed in tropical America and is separable from plants of the Old World frequently identified with it. It has been usually called *G. herbacea* (Jacq.) Schum., but that name is based on *Psychotria herbacea* Jacq., Enum. 16 (1760) & Sel. Stirp. 66, t. 46 (1763), which is antedated by *Rondeletia repens* L. Syst. 928 (1759) and *Psychotria repens* Sandmark in L. Amoen. Acad. **5:** 377, 386, 387 (1759). (Fl. C. Z. p. 360, sub *G. herbacea*). *Johnston 475; Erlanson 417.*

Gonzalagunia panamensis (Cav.) Schum.

A much branched bushy plant 1–3 m. tall, with very slender, shrubby, strigose stems and branches, which was seen in low thickets along Canyon Road and on the fill along Red Hill Grade. The opposite lanceolate leaves, 10–15 cm. long and 2–4 cm. broad, have an acute base and a slenderly long, acuminate apex. The inflorescence is slender, very elongate, terminal, 15–34 cm. long, and bears numerous tubular white flowers about 15 mm. long. The fruit is depressed globose, slightly fleshy, and 3–4 mm. long. Flowering occurs during the wet season. The species ranges from Mexico to Colombia and Venezuela. (Fl. C. Z. p. 356). *Johnston 76, 1317; Erlanson 544.*

Guettarda odorata (Jacq. ex L.) Lam.

A stiff, much branched, very twiggy bush or small tree 1.5–4 m. or rarely even 9 m. tall. It grows on islets along the shore, on and about sea cliffs, and on areas of thin soil, especially those near the coast, and is also found at the fringe of the forest surrounding the grassland at Bald Hill. Where present it tends to be locally rather common. Good examples of the plant may be studied near the lookout at East Harbor.

The plant has opposite, widely spreading twigs which persist in numbers on older branches and, upon hardening, become somewhat pungent. The opposite leaves have a slight brownish cast and are lanceolate to ovate or elliptic and 3–6 cm. long and 12–38 mm. broad. They are lustrous and glabrous above and dull, paler, and sparingly clad with inconspicuous appressed hairs along the midrib and veins beneath. The petioles are usually 2–5 mm. but rarely up to 8 mm. long. The stipules are 4–5 mm. long and early deciduous. During March and late February the plant sheds its foliage and then remains naked for about a month. After renewing its foliage it begins to flower in late May. The flowers are produced 5–15 together in small cymes borne on slender, elongate, axillary peduncles 2–6 cm. long. The small salmon-colored trumpet-like corollas are 8–15 mm. long and have a slender tube about 1 mm. thick and a limb of five lobes 6–9 mm. broad. The fruit is globose, 4–7 mm. in diameter, and is at first grayish green but finally becomes black at maturity. It has a very thin flesh surrounding a hard 5-celled stone. Produced in great numbers, the fruit becomes conspicuous on the plant in October and November.

The plant is known from Panama, Venezuela, and the southern West Indies (Trinidad and St. Vincent). Its basic name, *Laugieria odorata*, was originally published as a completely bare name by Jacquin, Enum. 16 (1760),

and first legitimately established by Linnaeus, Sp. Pl. ed. 2, 276 (1762), who associated it with "Edechia," a plant of eastern Venezuela described by Loefling, Iter Hispan. 259, 271 & 306 (1758). This latter appears to be the same as our Panamanian plant. Subsequently, Jacquin, Sel. Stirp. 64, t. 77, f. 21 (1763), published an account of his species. He mentioned the "Edechia" of Loefling and described a plant cultivated at Vienna grown from seeds said to have come from Havana or Cartagena. This cultivated material, as is clearly shown by his colored illustration, published still later, Sel. Stirp. Pict. t. 259, f. 16 (1780), is not our plant. The name *Laugieria odorata*, however, was first given a definite application by Linnaeus, and it must be applied in his sense. (Fl. C. Z. p. 359). *Johnston 168, 488, 1336; Erlanson 155, 389, 436, 519; Harlow 85.*

Hamelia nodosa Mart. & Gal.

A shrub 9–45 dm. tall growing in damp, shady, streamside forest in Pump Ravine and in Area 11D, on sunny seaward slopes at the west corner of Area 11A, and on a sheltered place on a sea cliff at East Harbor. The leaves, 8–20 cm. long and 4–9 cm. broad, are occasionally opposite but are usually borne whorled and 4 at each stem node. The flowers, borne in a loose terminal inflorescence, appear during the rainy season. They are at first orange but later become red. The tubular corolla is about 15 mm. long. The fruit is a juicy cylindrical or ellipsoidal berry 8–10 mm. long. It is pink or red when immature but eventually becomes brownish purple when ripe. The species ranges from Mexico to Panama. (Fl. C. Z. p. 358). *Johnston 147, 359, 1059; Erlanson 381.*

Isertia Haenkeana DC. CANELITO

A coarse bushy shrub, 2–4 m. tall, frequent in thickets and at forest margins, particularly on the western side of the island. A very conspicuous and ornamental plant during the wet season when it is in flower. The large opposite leaves, 1.5–4 dm. long and 7–18 cm. broad, are green and glabrous above, minutely pubescent and paler beneath, and usually broadest above the middle. They have evident parallel veins and a petiole 3–10 cm. long. The coarse stipules are 5–7 mm. long. The inflorescence terminates the branches, is much branched, and becomes 15 cm. long and nearly as broad. The tubular, nearly glabrous corollas, 2.5–3.5 cm. long, are yellow and contrast with the bright red color of the pedicels, fruit and branches of the inflorescence. The fruit is depressed globose, usually 6-celled, and 7 mm. in diameter. The plants flower profusely during the wet season and in diminishing quantity during the early months of the dry season. The species is known from Cuba, Central America, and Colombia. (Fl. C. Z. p. 350). *Johnston 77; Erlanson 111, 264, 306.*

Macrocnemum glabrescens (Benth.) Wedd.

A tree 3–20 m. tall which occurs in limited numbers locally in well watered forests at a few places on the island. It was found most abundant about the margins of the streamside forest in Area 11B, on the wet forested north slope of Red Hill, and in the forested canyon in Area 8D. A single small tree was noted in the forest in Camp Valley and several others near the coast east of Area 8D. The trees occur scattered. They do not stand out in the

forest except for a few weeks during January and February, when they produce their profuse display of pink flowers. The dark brown trunk is very irregular in cross section, being very strongly and irregularly ribbed and grooved and rather suggestive of moderately grooved trunks of *Pouteria* and *Ficus*.

The opposite leaves, 8–15 cm. long and 4–7 cm. broad, are widest above the middle and have an acute base and an abruptly short-acuminate apex. The petioles are 1–2 cm. long. The ovate stipules, about 1 cm. long, are early deciduous. The abundant pink flowers are borne in crowded groups in innumerable much branched terminal inflorescences. When in full flower the tree may become almost a solid mass of pink. The corolla has a limb 10–13 mm. broad surmounting a tube 6–8 mm. long. It is mostly pink, but tends to be reddish or somewhat purplish about the throat within. The fruit is an elongate pod 12–20 cm. long which splits at maturity, generally during April, freeing the great number of tiny seeds it contains. The species is known only from Panama and Costa Rica. (Fl. C. Z. p. 355). *Johnston 689, 1271, 1309, 1366; Erlanson 537.*

Mitracarpus breviflorus Gray

An herb common on barren rocks along the coast and on areas of thin soil on slopes and cliffs near the sea. It is a light green, slender, simple or sparingly branched annual 1–6 dm. tall, which becomes most abundant and conspicuous around the close of the rainy season.

The species is known from Arizona, Mexico, Costa Rica, and Panama. It has been confused with the widely ranging *M. hirtus* (L.) DC. It differs, however, not only in being a slender, erect, light green plant, but also in having stems that are very sparingly hairy, as well as leaves that are narrower, less evidently veined, and usually glabrous and somewhat lustrous above. Its seeds are also very different. Both species have seeds with diagonally crossed grooves on the ventral surface. On the doral face of the nutlet in *M. breviflorus,* however, there is an additional cross formed by a longitudinal and transverse groove, which is absent on the seeds of *M. hirtus.* Another difference is found in the surface of the seeds, which is noticeably more coarsely and strongly alveolate in *M. hirtus* than in *M. breviflorus.* (Fl. C. Z. p. 363, sub. *M. hirtus*). *Johnston 60, 189, 822A, 930A, 952; Erlanson 584; Harlow 55.*

Palicourea guianensis Aubl.

A shrub 2–3 m. tall, collected in thickets in Area 8D and at the edge of the forest surrounding the grassland at Bald Hill. The glabrous, opposite, strongly parallel-veined leaves, 10–30 cm. long and 5–13 cm. broad, are broadest at or below the middle. The petioles are 1–5 cm. long and the stipules are coarse and 5–10 mm. long. The inflorescence is a stalked, pyramidal, terminal panicle 5–10 cm. broad which has purplish branchlets at maturity. The tubular yellow corolla, 10–12 mm. long, is densely and minutely pubescent in the bud. The calyx is red. Flowering occurs early in the wet season. The fruit is a black berry 4–5 mm. in diameter. The species is widely distributed in the American tropics. (Fl. C. Z. p. 363). *Johnston 54; Erlanson 275, 557.*

Palicourea triphylla DC.

A shrub 18 dm. tall found by Erlanson flowering in mid-June in the thickets bordering Bald Hill. The leaves, three in a whorl at each stem node, are oblanceolate, 12–24 cm. long, 3–6.5 cm. broad, and borne on petioles 1–2 cm. long. The coarse stipules are up to 1 cm. long. The inflorescence is an elongate panicle about 3 cm. broad, borne on a very elongate peduncle. The corolla is tubular, yellow, about 1 cm. long, and minutely hairy outside. The calyx and pedicels are red. The plant ranges in Central America and northern South America. *Erlanson 280.*

Psychotria cuspidata Bredem.

A small bush 12 dm. tall found in shady forest in Area 8C by Erlanson. It has opposite lustrous leaves 7–14 cm. long and 3–6 cm. broad, which are obtuse at the base and slenderly long-acuminate at the apex. The petiole is 5–13 mm. long. The stipules are subulate and 1–2 mm. long at first, but in age may become 3 mm. long. The flowers, collected at the end of June, are borne in a much-branched, short, well-stalked terminal panicle 2 cm. or more broad. The corolla is about 5 mm. long, and, though white when fresh, dries a conspicuous vermilion. The species is widely distributed in tropical America. (Fl. C. Z. p. 361). *Erlanson 385.*

Psychotria fruticetorum Standley

A small to large, slender-stemmed bush 5–30 dm. tall, growing in dense forest shade at Bald Hill, in Areas 3A and 3D, and along the boundary between Areas 3 and 4 over a half-mile east of South Road. The opposite oblanceolate glabrous leaves, 4–10 cm. long and 1.5–4 cm. broad, are dark green above, pale beneath, and pointed at both ends. Their petioles are 5–10 mm. long. The stipules fall early. They are about 2 mm. long, semicircular in outline, and usually bear two aristae, each 1–2 mm. long. The flowers are borne in small stalked terminal panicles 1–4 cm. broad, and have white corollas 3–4 mm. long. The fruit is a red berry about 4 mm. in diameter. The plant begins flowering early in the rainy season and continues to flower and fruit as late as January. The species is known from Tabasco, Yucatan, British Honduras, Honduras, and eastern Guatemala and has not previously been reported from Panama. *Johnston 349, 1071; Erlanson 279, 516.*

Psychotria furcata DC.

A small slender-stemmed shrub growing on a terrace in a shady streamside forest near the middle section of Canyon Road. Only one plant, 12 dm. tall, was seen. It was fruiting in early October. The opposite, almost glabrous leaves, 5–9 cm. long and 1.5–3 cm. wide, are lustrous and dark green above, paler and dull beneath, and broadest at or below the middle. Their base is acute and their apex is acuminate. The petiole is 2–4 mm. long. The stipules have two persisting erect bristle-like lobes 3–4 mm. long. The inflorescence, a very crowded, few-flowered cluster with conspicuous bracts, is borne on an erect pubescent terminal peduncle about 1 cm. long. The bracts become reflexed at maturity, are 1–2 cm. long and 1.5–3 mm. broad, and, along with the axis of the flower cluster, are more or less violet-colored. The fruit is a purplish brown berry 3–4 mm. in diameter.

The species is known only from Panama. Most botanists have not distinguished it from *P. involucrata* Sw., from which it is separated by smaller leaves, fewer-flowered smaller inflorescences, and very large reflexed bracts. Actually, its closest relative appears to be *P. Hoffmannseggiana* of the Guianas and Brazil. (Fl. C. Z. p. 361, sub *P. involucrata*). *Johnston 87.*

Psychotria horizontalis Sw.

A slender-stemmed shrub 1–3 m. tall growing in shady forests. It has been found at Bald Hill, in Area 8D, in Camp Valley, between Areas 3 and 4, and on the coastal bluffs at East Harbor. The opposite leaves, 5–13 cm. long and 2–6 cm. broad, are pointed at both ends and have a pale lower surface. The stipules are early deciduous, 4–6 cm. long, and triangular-ovate. The flowers are borne in stalked terminal panicles 2–4 cm. broad. They have a white corolla 5–6 mm. long, with recurved lobes. The fruit is a fleshy red berry 4–5 mm. broad which is surmounted by a persisting calyx with a tube almost 1 mm. long and five slender outcurving lobes 1–2 mm. long.

The species ranges from Mexico and Cuba southward into northern South America. Our plant is referable to *P. longicollis* Benth. It is the common Central American form which differs from the typical plant of the West Indies in its elongate calyx lobes. (Fl. C. Z. p. 362). *Johnston 18, 18A; Erlanson 213, 236, 447, 556.*

Psychotria marginata Sw.

A slender shrub 1–2 m. tall growing in the shade of the high streamside forest in Area 11B. The opposite leaves, 10–22 cm. long and 3–7 cm. broad, are broadest at or above the middle, pointed at both ends, practically glabrous, and borne on petioles 5–20 mm. long. The stipules are distinct at the base, 8 mm. long, 4 mm. broad, and deciduous. The inflorescence is a large, long-stalked, much branched, very open panicle 10–15 cm. long and nearly as broad. The corolla, 4 mm. long, is lemon yellow. The plant, observed only on January 22, was then flowering. A species widely distributed in tropical America. (Fl. C. Z. p. 362). *Johnston 1218.*

Psychotria patens Sw.

A slender-stemmed shrub 1–3 m. tall growing in forest shade at Bald Hill and on Punta del Cabo. The opposite leaves, 10–15 cm. long and 4–6 cm. broad, have an acuminate apex, an obtuse base, and a petiole 5–8 mm. long. The stipules are subulate, 5–10 mm. long, erect, herbaceous, and tardily deciduous. The small white flowers are borne in a very loosely branched elongate terminal panicle 2–3 cm. broad which becomes purplish in age. The fruit is a juicy white or pinkish berry about 4 mm. in diameter. The species is widely distributed in the American tropics. (Fl. C. Z. p. 362). *Johnston 49; Erlanson 48, 392.*

Psychotria undata Jacq.

A small unobtrusive shrub, 1–2.5 m. tall, occasional in shady forests. It is the most abundant and widely distributed member of its genus on the island, but is not a common plant. The herbage is pubescent with soft brownish hairs which are especially noticeable on twigs, inflorescence, and midrib of leaves. The opposite leaves, 10–18 cm. long and 2–5.5 cm. broad, are broadest at or above the middle, pointed at both ends, and borne on a petiole

2–5 mm. long. The stipules are broad, obtuse, united at the base, and deciduous. The white flowers, 4–5 mm. long, are borne in stalked clusters at the ends of the twigs. They are dimorphic, on some plants having conspicuously exserted stamens and included styles, and on others a long exserted style and included stamens. Flowering begins early in the rainy season and continues in diminishing amounts into the months of the dry season. The fruit is a sparsely hairy, ellipsoidal red berry 5–6 mm. in diameter and contains two small stones strongly 3-ribbed on the back.

The species ranges from Bermuda, Florida, and southeastern Mexico south to Colombia and Venezuela. It is extremely variable. Typical *P. undata*, based upon material from the Bermudas, is a slender glabrous plant with abundantly flowered, repeatedly branched, open glabrous inflorescences. The hairy form on San Jose may be distinguishable under the name *P. hirta* Willd. (Fl. C. Z. p. 362). *Johnston 142, 297, 314; Erlanson 61, 407, 475, 517.*

Sabicea villosa R. & S.

A slender-stemmed twining vine which drapes shrubs and low trees in second growth. It was not observed in 1944, but by 1946 it had become frequent along many roads on the island. The plant luxuriates during the rainy season and dies back early in the dry season. The leaf-bearing stems are light-colored and coarsely strigose. The opposite leaves, 5–10 cm. long and 2–4 cm. broad, are dark above, pale beneath, and bear some appressed hairs, especially along the midrib and veins beneath. The petiole is 5–10 mm. long. The stipules are broad and usually about 5 mm. long. The rather inconspicuous slender white flowers, about 5 mm. long, are coarsely appressed-hairy and are borne in dense sessile clusters in the leaf axils. The calyx lobes are 3–4 mm. long, 1 mm. broad, green, and recurving. The fruit is a dryish, brownish purple, broadly ellipsoidal berry 1 cm. long, which is sparsely strigose and crowned by the conspicuous persisting calyx. The species is widely distributed in tropical America. (Fl. C. Z. p. 357, sub *S. hirsuta*). *Johnston 1135; Erlanson 497.*

CUCURBITACEAE

Cayaponia racemosa (Mill.) Cogn.

A vigorous, large herbaceous vine with usually forked tendrils. It forms extensive drapery on thickets, forest margins, and on isolated trees in open forests, and usually half smothers the plant supporting it. The plant probably has a large underground storage organ, since all of its great development of stems and herbage lasts only one season and is developed anew each year. The period of active growth probably begins early in the rainy season. The plant fruits in January and February and has died back to the ground by the end of March. By cutting the main stems, one vine was found to have reached the top of a tree 18 m. tall and to have produced a half smothering mass of drapery on this tree and several adjoining it. This particular vine had several main stems which were 4–7 cm. thick a decimeter above the soil. The species is a common one on the outer half of the eastern peninsula and is particularly abundant in the vicinity of the rock crusher at East Harbor. A few scattered plants were seen along Met Road and near by along the Loop, and others were found in a bit of open forest near Volmers Lane in Area 7A.

The leaves vary in form from ovate to 5-lobed and are 5–15 cm. long and 2–13 cm. broad. They are somewhat harsh to the touch and have 3 strong ribs (with the lateral ones soon forking) diverging from the base. The petiole, 1.5–6 cm. long, is narrowly winged above the middle. The flowers are unisexual, yellowish, 10–12 mm. broad, and mostly borne in loose racemes usually 1–2 dm. long. The ellipsoidal fruit, 10–14 mm. long, becomes orange when ripe. Produced in tremendous quantities, it attracts attention in February. The species ranges from Mexico and the West Indies into northern South America. (Fl. C. Z. p. 369). *Johnston 843, 844, 1401.*

Melothria guadalupensis (Spreng.) Cogn.

A slender herbaceous vine with simple coiled tendrils. It was observed only in second growth near the main road east of Camp. The 5-angled, palmately ribbed leaves, 3–5 cm. long and nearly as broad, are moderately harsh to the touch. The petiole is 2–3 cm. long. The minute unisexual flowers are yellow. The fruit is ellipsoidal, striped like a watermelon, 1–1.5 cm. long, and pendent on slender pedicels 2–3 cm. long. The species ranges from Mexico and the West Indies into northern South America. (Fl. C. Z. p. 368). *Johnston 397.*

Melothria trilobata Cogn.

A slender herbaceous vine with simple tendrils which drapes with netted growth small areas of thicket and second growth. It is not uncommon on the northern and eastern parts of the island. The leaves are usually deeply 5-lobed, 5–14 cm. long, and nearly as broad. The petioles are 2–7 cm. long. The small unisexual flowers are yellow. The fruit is broadly ellipsoidal, shiny, striped, suggestive of a diminutive watermelon, and usually 2.5–3.5 cm. long. It is borne pendent on a pedicel up to 1 cm. long. The vine begins to dry up in January, but the small watermelon-like fruits remain green and may be found hanging from the dead stems until the end of February. The species is known from Costa Rica, Panama, and northern South America. (Fl. C. Z. p. 368). *Johnston 371; Erlanson 504.*

COMPOSITAE

ANTHEMIS COTULA L. MAY WEED

Scattered flowering and fruiting plants were observed at the Goat Barn in January 1946. A European plant widely established as a weed in United States. Apparently introduced on San Jose in unclean hay shipped from New Orleans.

Baccharis trinervis (Lam.) Pers.

Only a single individual was found on the island. It was a female plant just starting to flower and was discovered in February 1946 at the south end of the East Loop. The plant was rooted in the roadside ditch and had a single elongate sparingly branched stem 3 m. long, scrambling off into adjacent undisturbed thicket. It was obviously less than two years old. The grayish leaves are 3-ribbed, lanceolate, 5–9 cm. long and 1.5–3.5 cm. broad. They have an acute base, an acuminate apex, and a petiole 5–10 mm. long. The small white unisexual heads are borne in small panicles along the leafy stems. The species is widely distributed in tropical America. (Fl. C. Z. p. 378). *Johnston 1399.*

Brickellia diffusa (Vahl) Gray

An erect annual occasional in low thickets and at roadsides in the northern part of the island. It is conspicuous during January when it becomes 5–15 dm. tall. Its pale slender leafy stems become much branched above the middle, thus forming an airy, loose, elongate panicle which bears great numbers of slender elongate greenish heads about 6 mm. long. The leaves are opposite along the main stem, deltoid in outline, crenate on the margin, and 1.5–6 cm. broad. The petiole is 5–30 mm. long. The species is widely distributed in tropical America. (Fl. C. Z. p. 378, sub *Coleosanthus diffusus*). *Johnston 1281, 1308.*

Calea prunifolia HBK.

A much branched, slender-stemmed shrub found in sunny open places in all parts of the island. It forms a dense bushy growth 1–2 m. tall or scrambles and climbs on forest margins to the height of 6 m. The plant becomes most abundant in areas of low thicket, especially those within a half-mile of the coast. On cliffs and islets along the shore it frequently associates with plants characteristic of thin soil.

The twigs are brownish from a coating of appressed, short stiff hairs. The opposite, elliptic to ovate leaves, 4–10 cm. long and 2–7 cm. broad, are broadest at or below the middle. They are dark green and scabrid above, and below are pale, prominently ribbed and veined, and abundantly dotted with very minute golden resinous glands. Their margins are usually narrowly revolute and, in larger leaves, usually sparingly serrate. The petiole is 3–15 mm. long. On warm days the herbage is somewhat aromatic with an odor suggestive of beeswax. The yellow florets are borne in heads about 8 mm. long and 5 mm. thick, produced in umbellate clusters along the leafy twigs during the rainy season. Producing its yellow heads in great profusion during September, October, and November, the plant becomes one of the most common colorful shrubs of that season. The species is known only from Panama and Colombia. (Fl. C. Z. p. 384). *Johnston 29, 1038; Erlanson 394; Harlow 19.*

Clibadium appressipilum Blake

A bushy shrub 1.5–3 m. tall, rare in undisturbed open places on the outer headland of Punta del Cabo and occasional in disturbed soils in former thicket area southwest of Camp and in Area 3. Its many slender stems are clothed with short appressed hairs. The opposite lance-ovate leaves, 7–15 cm. long and 3–9 cm. broad, have an obtuse base, an acuminate apex, and a toothed margin. They are grayish green above, pale below, and prominently ribbed and veined. The midrib is palmately forked 5–10 mm. above the base of the blade. The petiole is 1–2.5 cm. long. The heads, containing a few whitish florets, are 3–4 mm. in diameter and are borne at the ends of the leafy twigs in corymbose clusters 3–5 cm. in diameter. The plant comes into flower in August and has been found blooming as late as January. The species is known only from Panama. *Johnston 1069; Erlanson 561; Harlow 2.*

Conyza lyrata HBK.

A coarse annual herb 5–10 dm. tall, with strongly scented, clammy, viscid herbage. The leaves, up to 15 cm. long, are lyrately lobed and sharply

toothed on the margin. The greenish heads of purplish florets are borne in a panicle. The plant was first observed when flowering, in February 1946. Two plants were found along the jeep trail into Area 11A, several more at the roadside near the Engineers' Camp, and perhaps a dozen scattered along East Road near the Air Strip. Though the plant was found only in disturbed places, and always in the company of at least one evidently introduced species, I am inclined to believe that it is a native of the island. The species is widely distributed in tropical America. (Fl. C. Z. p. 378). *Johnston 1332.*

Eclipta alba (L.) Hassk.

A slender, much-branched, usually decumbent herb with opposite lanceolate leaves and small, slenderly pedunculate heads of whitish florets produced from the leaf axils. It was one of the first of the common tropical weeds to follow the Army to San Jose Island. A colony, fruiting profusely, was found in the Camp Area near the officers' tents early in October 1944. The following March it was rare in the Camp Area but well established in damp soil near by at Main Beach and at E. M. Beach. The following September Harlow collected it along the road near the Goat Barn. In January 1946 it had become common at intervals in roadside ditches between the Goat Barn and the Cross Roads and was first discovered on the fill at the lower end of Red Hill Grade. The plant is a widely distributed weed in the tropics. (Fl. C. Z. p. 380). *Johnston 89, 756; Erlanson 333; Harlow 21, 51.*

Elephantopus mollis HBK.

A perennial herb growing locally at the margin of the forest surrounding the grassland at Bald Hill. It is clothed with appressed hairs and has elongate, simple, leafy, erect or decumbent stems 1–2 m. long. The oblanceolate leaves, 1–1.5 dm. long and 3–4 cm. broad, have crenate margins and are evidently appressed-hairy beneath. The heads are globose and contain numerous cream-colored florets and intermixed papery bracts. The species is widely distributed in tropical America. (Fl. C. Z. p. 375). *Johnston 1061.*

Elephantopus spicatus Juss.

A single plant was found in December 1946 growing at the roadside with second growth near the Guard House at Camp. It was much branched, bushy in growth, and about 6 dm. tall. The elongate heads, containing pink florets, are clustered along the stem in a spicate arrangement. The plant is apparently a weedy introduction from the Isthmus. A weedy plant widely distributed in the tropics. (Fl. C. Z. p. 376, sub *Pseudelephantopus spicatus*). *Johnston 971.*

Eleutheranthera ruderalis (Sw.) Sch. Bip.

A small annual herb with loosely branching prostrate or decumbent stems. The opposite ovate leaves, 2–4 cm. long and 1–2 cm. broad, have crenate margins and a petiole 5–10 mm. long. The small heads of yellow florets are produced in the leaf axils. Late in December 1945 the plant was found growing between grass clumps in damp soil in undisturbed portions of the grassland at Bald Hill, where it gave every evidence of being a native plant. Where seen elsewhere on the island, it acted like a recently introduced weed. It was first collected on San Jose on the clearing back of Main Beach by

Erlanson in mid-May 1945. In June of the same year it was found at the Navy Station. In January 1946 it was still growing at Main Beach and the Navy Station and was a weed in the new lawns at Camp, and was also associating with introduced weeds along East Road near the Air Strip. The species is widely distributed in tropical America. (Fl. C. Z. p. 381). *Johnston 890, 990, 1102; Erlanson 147, 360, 595.*

EMILIA SONCHIFOLIA (L.) DC.

An erect herb with toothed, lyrate stem-leaves. The cylindrical heads of purple florets, borne in clusters, are 10–12 mm. long. The species is clearly a recent introduction from the mainland. It was first found on the island at the Navy Station by Erlanson in June 1945. In January 1946 it was still common at the Navy Station and had appeared as a weed in the lawn at Main Camp. The species is a native of the Old World but is now widely established in the American tropics. (Fl. C. Z. p. 385). *Erlanson 351.*

Erechtites hieracifolia (L.) Raf.

A juicy herb 5–10 dm. tall with toothed leaves and heads of pinkish florets 10–15 mm. tall. Occasional in disturbed soil. Widely distributed in warmer parts of America. (Fl. C. Z. p. 385). *Johnston 691.*

ERIGERON BONARIENSIS L.

A coarse, unattractive weedy herb with usually erect leafy stems about 1 m. tall, many narrow, more or less sinuately toothed leaves, and abundant tiny greenish heads borne in an elongate terminal panicle. It is apparently a recent introduction from the Isthmus. It was first seen in March 1945 when it was frequent along the road in the vicinity of the Motor Pool and Supply Office. A year later it had become a frequent weed along all the principal roads on the island. The species is widely distributed in the warmer parts of America. (Fl. C. Z. p. 378). *Erlanson 195.*

ERIGERON STRIGOSUS (Walt.) BSP.

Collected by Erlanson in July 1945 at the Goat Barn. It is a slender herb about 7 dm. tall bearing most of its leaves crowded towards the base. The heads have yellow disk-florets and very numerous white rays. Though searched for, the plant was not rediscovered at the Goat Barn in 1946. It had evidently been introduced on the island in unclean hay shipped from New Orleans. The species is native of eastern United States. *Erlanson 467.*

Eupatorium odoratum L.

A small bushy shrub 1–2.5 m. tall, occasional in thickets and in open mixed forest. It is widely distributed on the island but not common and attracts attention only when in full flower during December and early January. The opposite, triangular-ovate leaves, 4–10 cm. long and 1.5–5 cm. broad, have a crenately toothed margin, an acuminate apex, and a broad base abruptly contracted into a petiole 5–22 mm. long. The heads of lavender florets are cylindrical, nearly 1 cm. long, and are borne in corymbose clusters terminating the leafy twigs. When in full flower the plant is a mass of lavender, and rather fragrant. The species is widely distributed in tropical America. (Fl. C. Z. p. 376). *Johnston 783, 846.*

Lycoseris latifolia (Don) Benth.

A plant with very elongate shrubby stems which clamber and trail over low thicket. Its large orange-colored thistle-like heads and its triple-ribbed leaves, green above and pure white beneath, attract attention and allow it to be quickly identified. The plant was found in colonies here and there scattered widely over the northern half of San Jose, but on the southern half of the island it was seen only along the road east of Max Point. It is not a common plant. Good colonies of it, readily accessible, occur at the junction of Met Road and the Loop and along the Jeep Trail at the east corner of Area 11A.

The stems are usually less than 6 mm. thick. They are loosely branched, may reach a length of 5 m., and are renewed each year. New growth begins late in the rainy season. The vigorous new shoots with their distinctive foliage begin to emerge from the thicket in late October and early November. The leaves, 6–18 cm. long and 2.5–6.5 cm. wide, are broadest at or just below the middle, pointed at both ends, green and lustrous above, and white and permanently arachnoid-tomentose beneath. The midrib is triple forked 5–30 mm. above the base to form 3 strong longitudinal ribs. The petiole, 2–15 mm. long, is usually short. The leaf-margin may be conspicuously and sharply toothed on the early leaves, but on the mature plant it is usually entire or only very obscurely and finely serrate.

The plant flowers during January and February and is unisexual. The heads are somewhat thistle-like, borne terminating leafy twigs, and differ, according to sex, in size, proportions, and even color. The heads produced by male plants are 2–2.5 cm. in diameter, orange-colored, and have numerous conspicuous ray-florets. The limb of the rays is 6–11 mm. long, 2–2.5 mm. broad, and 3-toothed or lobed. The heads on the female plants are 3–4 cm. in diameter and their florets are yellow-orange in color. The ray-florets are very inconspicuous, having a limb about 5 mm. long that is cuneate and deeply 3-lobed. The rays in the two sexes have styles, but no anthers, and are sterile. The disk-florets in the male heads are hermaphroditic but never mature fruit. No anthers are produced by any of the florets in the female heads, but only the disk ones mature fruit.

The species is known only from Panama and northern Colombia and Venezuela. It is readily distinguished from other species known from Central America by having involucre bracts that are scabrous on the inner surface towards the tips. The name *L. triplinervia* Less. may possibly be the correct name for this plant. (Fl. C. Z. p. 385, sub *L. oblongifolia*). *Johnston 463, 587, 1286, 1333, 1333A; Erlanson 384.*

Melampodium divaricatum (Rich.) DC.

An introduced weed well established about the Navy Station, where it was first collected by Erlanson in June 1945. Six months later it had appeared at Camp and was a common weed in the new lawns. It is an herb with erect or widely spreading stems, opposite ovate leaves, and heads of orange-yellow florets borne on slender peduncles at the forks of the stem. The rays are evident and numerous but short. The species is widely ranging in the American tropics. (Fl. C. Z. p. 379). *Erlanson 365, 500, 594.*

Melanthera nivea (L.) Small

A very loosely and much branched slightly shrubby plant 1–2.5 m. tall which was first observed in January 1946. It was abundant at the shore end of the then abandoned and partially overgrown Mortar Road and was locally common about the disturbed summit of the steep seaward slope back of the Chapel at Camp. The plants found near the Chapel conceivably could be a recent introduction from the Isthmus, but those on Mortar Road are probably native.

The plant is green, rather herbaceous, and pubescent with short stiff hairs. The opposite leaves are crenate-toothed and 5–10 cm. long. Those from Mortar Road are triangular-ovate and nearly as broad as long, while those from near the Chapel are elongate and subhastate. The heads are about 1 cm. in diameter and bear numerous white florets and no rays. This is a very variable species ranging from Mexico and Cuba south to Venezuela and Peru. (Fl. C. Z. p. 381, sub *M. aspera*). *Johnston 1100, 1203.*

Mikania cordifolia (L.) Willd.

A coarse twining leafy herbaceous vine growing over bushes on the sunny bank of a ravine in Area 7C. The opposite juicy deltoid leaves, 6–15 cm. long and nearly as broad, have a cordate base and a weakly toothed margin. The petiole is 3–10 cm. long. The cylindrical heads of white florets, 7–9 mm. long, are borne crowded in axillary corymbs and mature during late January. The plant much resembles the common *M. micrantha* but is a much coarser plant with larger leaves and much larger heads. The species is widely distributed in tropical America. (Fl. C. Z. p. 377). *Johnston 1348.*

Mikania Guaco H. & B.

A coarse, high-climbing, herbaceous twiner growing on sheltered, partially shaded forest margins. It was seen in the streamside forest in Area 11B, on the Loop near Little Butch Trail, and along the Marino near the Red Hill Bridge. The opposite, entire, ovate or elliptic leaves, 10–25 cm. long and 5–15 cm. broad, have a rounded or acute base and a usually acuminate apex. The petiole is as much as 6 cm. long and frequently has the blade somewhat decurrent upon it. The florets, matured in early February, are dirty white and borne in cylindrical heads 7–10 mm. long, produced abundantly in loose axillary corymbs. The species is widely distributed in tropical America. (Fl. C. Z. p. 377). *Johnston 1031, 1279, 1319, 1372.*

Mikania leiostachya Benth.

A leafy twining vine which grows rapidly early in the dry season and spreads over thicket and climbs high on sunny forest margins. The light green lance-ovate leaves, 7–23 cm. long and 3.5–14 cm. broad, are firm, veiny, and lustrous above. Their apex is slenderly acuminate and their base rounded, or frequently somewhat cordate. The petiole is 1–5 mm. long. The tiny white florets, produced in tiny cylindrical heads 5–6 mm. long, are borne in great numbers, sessile and spicate, along the branches of a large terminal panicle 3–10 dm. long. These elongate inflorescences, yellowish in color, appear in great numbers at the end of January, and for several weeks are conspicuous here and there on treetops and thickets in all parts of the island. The species ranges in Central America and south to Ecuador. (Fl. C. Z. p. 377). *Johnston 1329, 1352, 1370, 1396.*

Mikania micrantha HBK.

In November 1944 a few plants of this slender twining vine were observed near the eastern point of the island. The following March it had become a common plant in second growth, especially along roads. By 1946 it was generally distributed, and along many sections of road it draped new growth profusely, but showed little tendency to spread into adjoining undisturbed vegetation. The plant begins vigorous growth towards the close of the rainy season and begins to flower abundantly in December. The opposite deltoid leaves, 5–7 cm. long and 4–6 cm. broad, have a cordate base, an acuminate apex, and a somewhat toothed margin. The tiny whitish florets are produced in tiny cylindrical heads 4–5 mm. long which are borne in great numbers in small axillary corymbs. A species very widely distributed in tropical America. (Fl. C. Z. p. 377). *Johnston 356.*

Neurolaena lobata (L.) R. Br.

A coarse herb with leafy, sparingly branched erect stems 1–3 m. tall, growing here and there at roadsides and in low thickets. The stem-leaves are 10–25 cm. long, usually more or less deeply and conspicuously 3-lobed, toothed on the margin, and somewhat scabrous above. The yellow florets are borne in yellow cylindrical heads 6 7 mm. long that are produced in great numbers and form a large terminal panicle. The species is widely distributed in tropical America. (Fl. C. Z. p. 385). *Johnston 577; Erlanson 49, 220.*

Pectis elongata HBK.

A small slender loosely branched strong-scented herb 1–3 dm. tall, frequent about thin soil on the bluffs near South Beach and about the cliffs at East Harbor. The opposite elongate leaves are dotted with glands and are ciliate towards the base. The small narrow heads are produced in a loose paniculate cluster. The florets are yellow or orange and mature in August and September. The species ranges from Mexico and Cuba south to the Guianas and Peru. (Fl. C. Z. p. 384). *Johnston 172; Erlanson 571, 580.*

Sonchus oleraceus L.

A juicy annual herb with milky juice, lyrately lobed, prickly-margined leaves, and heads of yellow florets. The plant was probably introduced on the island in unclean hay shipped from the United States. In January 1946 it was found flowering and fruiting at the Goat Barn and also in a flower bed fertilized by goat manure near the technical buildings at Camp. The plant is European, but is now widely introduced around the world. *Johnston 1194.*

Spiracantha cornifolia HBK.

A slender erect herb bearing small leaves that are green above and are white beneath from a coating of hairs. The tiny purplish florets are borne amidst a capitate cluster of broad spine-tipped bracts. The straw-colored spine-tip terminating the leaves, and especially the bracts, allows the plant to be easily recognized. It is common about the head of the sea cliffs at East Harbor, on some of the areas of thin soil on the eastern peninsula, on the rocks and cliffs along the coast near Camp, and on thin soil at Max Point. In January 1946 it was found as a weed in the lawns at Camp, where

it may possibly represent an introduction from the Isthmus. The species is known from Central America and northern Colombia and Venezuela. (Fl. C. Z. p. 376). *Johnston 170, 1199.*

TRIDAX PROCUMBENS L.

An herb with decumbent or spreading stems, sparingly but prominently toothed opposite leaves, and yellowish heads of florets 5–7 mm. high produced singly on long peduncles from the ends of the branches. The plant is evidently a recent introduction from the Isthmus. It was first observed on the island at the Navy Station in November 1944. Erlanson collected it at Camp in July 1945 and Harlow found it near the Air Strip in the following September. In January 1946 I found it still common at the Navy Station, a common weed in the lawn at Camp, frequent along the road just north of the Goat Barn, and common along the roadside near the Air Strip. The species is a common weedy plant in tropical America. (Fl. C. Z. p. 384). *Erlanson 143, 552; Harlow 25.*

Vernonia canescens HBK.

Forming colonies in thickets and especially in those of low growth on slopes within a mile of the coast. The slightly shrubby slender stems, annually renewed, grow upward through the dense vegetation and become 1–3 m. in length. Most of them are erect, simple, and terminated by flowers, but some elongate ones may lie on the top of the thicket and produce a number of erect flowering branches. The leaves, confined to the exposed portion of the stems, are lanceolate to elliptic, 5–10 cm. long, 2–4.5 cm. wide, and broadest at or below the middle. They are rounded at the base, short-petiolate, acute at the apex, and have a pale green, evidently ribbed and veined lower surface that may be soft hairy when young. The heads of pink flowers are borne in large numbers in single ranks on simple or widely forking leafless short-peduncled inflorescences produced from the upper leaf axils. The plant begins its seasonal growth at the end of the wet season and begins flowering in January. This continues abundantly into March and in diminishing quantity through April, most plants, apparently, flowering several times during the season. The species ranges from Mexico into South America. (Fl. C. Z. p. 375). *Johnston 540, 593, 1087; Erlanson 71, 357; Campbell 10; Andersson.*

VERNONIA CINEREA (L.) Less.

An herb 3–10 m. tall bearing small heads of pink florets in large numbers in a loose inflorescence. The leaves have a well-developed winged petiole and an ovate crenate-margined blade which is pale and strongly veined on the lower surface. The plant is a recent introduction on the island. It was first discovered by Erlanson, who found it in May 1945 growing along the road near Main Beach. In January 1946 I found it occasional in the lawn at Camp and also present on the fill along Red Hill Grade. The species is native to the Old World but is now a widely established weed in the American tropics. (Fl. C. Z. p. 375). *Johnston 1001, 1198; Erlanson 142.*

Wedelia trilobata (L.) Hitchc.

An herbaceous plant with long trailing leafy stems. It grows in damp sandy soil along beaches, most abundantly in sheltered shaded places. It is extremely common at OrangeTree Beach, where it forms a ground cover over large areas under the palm trees. The opposite oblanceolate to hastate leaves, 4–15 cm. long and 1.5–5 cm. wide, are broadest above the middle and below are contracted into a distinctly winged petiole. The blade is frequently more or less 3-lobed. Its margin is finely crenate. The heads are 6–8 mm. broad and have yellow ray and disk florets. They are borne solitary on peduncles 3–12 cm. long springing from the leaf axils. Flowering occurs throughout the year. The species grows on and near coasts and is widely distributed in tropical America. (Fl. C. Z. p. 380). *Johnston 490; Erlanson 1; Harlow 23.*

NEW BOTANICAL NAMES

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EXPLANATION OF PLATES

Plate I

Map of San Jose Island.

Plate II

Vegetation map of island.

Plate III

Outer portion of eastern peninsula, viewed eastward towards Punta Cruz. A photograph made in early 1944 before construction of Air Strip. East Harbor is on the left with the Rock Crusher near by. Most of the vegetation consists of North Forest broken by areas of Thicket, but left of the Rock Crusher is an area of Deciduous Forest which shows light in color since it is in leafless condition. The bare patches above the seacliffs, left from the Crusher, are grassy areas among thickety growth developing on very thin soil and though small in size are notable for a very distinctive flora.

Plate IV

A view southeasterly over Area 11A towards the Bald Hill Grassland. Center of picture shows thickets with many vine-clad emergent trees and is typical of large areas on the northern half of the island. Bits of North Forest are to be seen on left and right.

Plate V

Site of Main Camp in early 1944. Viewed northward from Bodega Bay. Main Beach, in foreground, is backed by some Swamp Forest (chiefly *Mora*) and behind that by Camp Valley Forest. The forested headland of Punta del Cabo appears at right rear. The remaining vegetation is predominately Thicket with scattered emergent trees.

Plate VI

Vine stems in Marino Forest near East Loop. The broad undulating ribbony stems (Monkey Ladders) are those of *Bauhinia Thompsonii*. The more slender vine stems, hanging from the tree and lying in the foreground, belong to *Connarus panamensis*.

Plate VII

Pods of *Entada Gigas* from Punta del Cabo (J. *982*). Yardstick included for scale.

Plate VIII

Sea Beans. The six seeds on right are poised with micropyle uppermost while the remaining ones lie on their side with the micropyle directed towards the base of the page. Fig. 1. *Entada Gigas*. Three seeds, mahogany-colored. Fig. 2. *Dioclea* sp. One seed, light-colored with dark mottling. Fig. 3. *Dioclea megacarpa*. Three seeds, caramel-colored. Fig. 4. *Dioclea reflexa?* Four seeds, dark brown or blackish, sides flattened. Fig. 5. *Dioclea reflexa?* Four seeds similar to last but plump with convex sides. Fig. 6. *Mucuna Sloanei*. Four seeds, reddish brown in color. Fig. 7. *Mucuna Mutisiana*. Four seeds, dusky in color. Fig. 8. *Caesalpinia Bonduc*. Three seeds, gray.

Plate IX

Fruits and seeds from Beach Drift. Fig. 1. *Phytelephas* sp. Four seeds, lower left poised with rounded back downward to show large perforated attachment scar at narrow end. Fig. 2. *Bactris balanoides*. Three stones, lying on back and side. Fig. 3. *Manicaria saccifera*. Four seeds, one with adhering fragments of ovarial walls, another broken open to show hollow cavity lined with white "meat" and a third poised with the attachment end uppermost. Fig. 4. *Astrocaryum* sp. Five stones, three with adhering black fibers and the others worn and bleached. The lowermost stone is poised on its narrow end to show the characteristic pits at the larger end.

PLATE X

Fruits and seeds from Beach Drift. FIG. 1. *Calatola costaricensis* ? Four fruits (endocarps), one cut and placed to show outer end and inner cavity. FIG. 2. *Calatola venezuelana* ? One fruit (endocarp) in lateral view. FIG. 3. *Sacoglottis* sp. One fruit (endocarp) in lateral view. FIG. 4. *Abuta* sp. Seven fruits (endocarps); the lowest one split longitudinally. Fruit on far left may possibly represent a second species.

PLATE XI

Fruits and seeds from Beach Drift. FIG. 1. *Pterocarpus officinalis.* Seven fruits, worn and bleached. FIG. 2. *Hippomane Mancinella.* Seven fruits, the lowest cut vertically and placed to show inner structure and lateral outline. FIG. 3. *Spondias Mombin.* Four fiber-coated stones. FIG. 4. Unidentified seeds, see footnote p. 52. FIG. 5. Unidentified pod, three specimens with one on right cut transversely and placed to show inner structure and narrow outer edge. See footnote p. 52.

PLATE XII

Fruits and seeds from Beach Drift. FIG. 1. *Pelliciera rhizophorae.* Fruit in lateral view. FIG. 2. *Prioria copaifera.* Three fruits. FIG. 3. *Omphalea panamensis.* Six seeds Middle one of inner row poised with micropylar end uppermost, the others all lying on rounded back or angled ventrum. The one on lower right is cut open to show seed-walls and granular endosperm. FIG. 4. Unidentified fruit (endocarp). Three specimens, one cut in half and placed to show large cavity and outer end. See footnote p. 52.

PLATE XIII

Philodendron Erlansonii, n. sp. Two specimens, J. *967* and *974,* the former, on the left, being part of the type collection.

PLATE XIV

(Left) *Philodendron Harlowii,* n. sp. Type.
(Right) *Coccoloba Waittii,* n. sp. Type.

PLATE XV

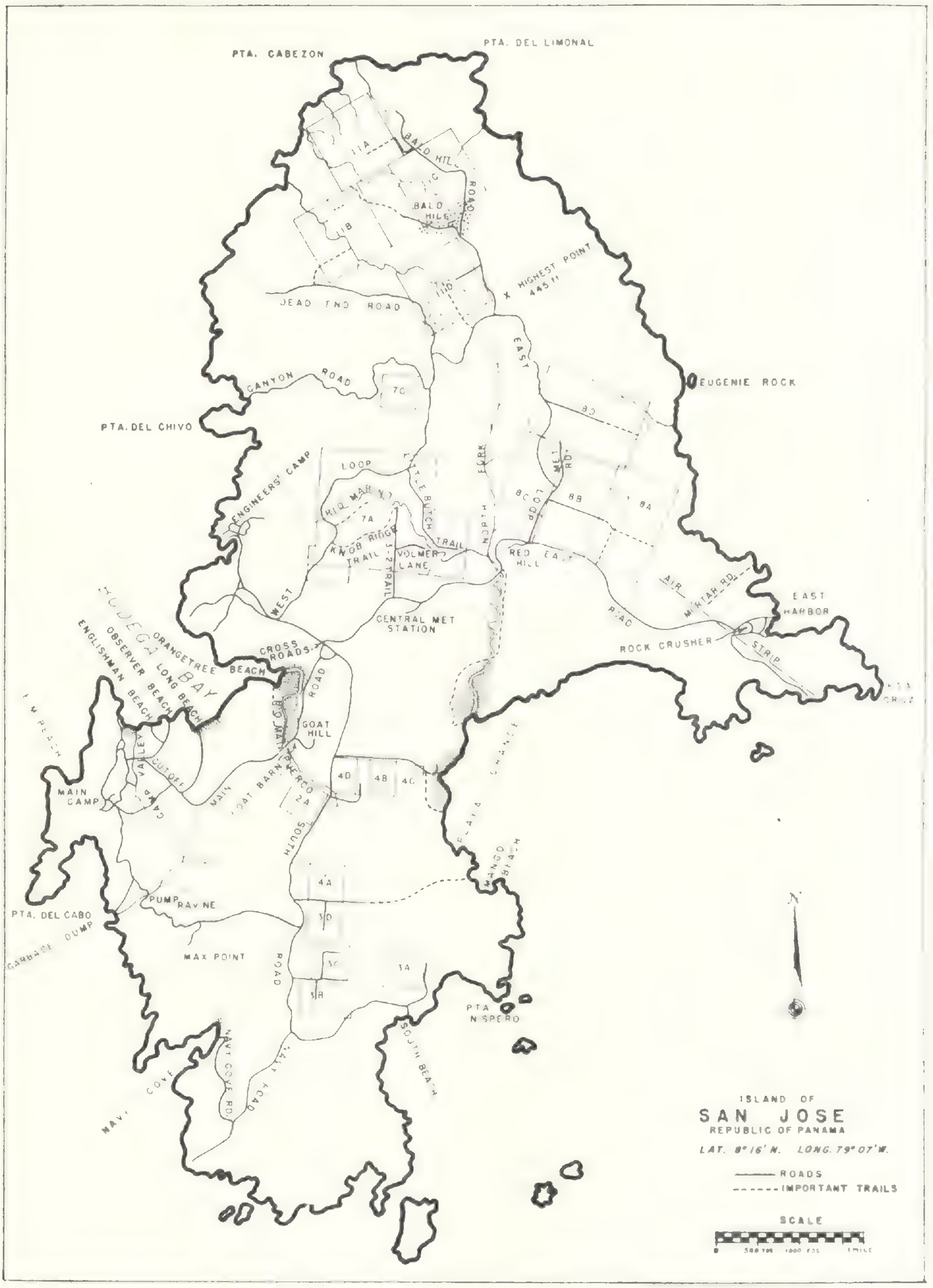
(Left) *Ficus Bullenei,* n. sp. Type.
(Right) *Ficus Campbellii,* n. sp. Type.

PLATE XVI

(Left) *Ficus Leavensii,* n. sp. Type.
(Right) *Bauhinia Thompsonii,* n. sp. Type.

PLATE XVII

(Left) *Protium McLeodii,* n. sp. Type.
(Right) *Solanum perattenuatum,* n. sp. Type.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PTA. DEL LIMONAL
BALO HILL
BALO HILL ROAD
X HIGHEST POINT 445 ft
DEAD END ROAD
CANYON ROAD
EUGENIE ROCK
PTA. DEL CHIVO
ENGINEERS' CAMP
LOOP
KNOB RIDGE TRAIL
VOLMER LANE
CENTRAL MET STATION
RED HILL
AIR MORTAR RD.
EAST HARBOR
ROCK CRUSHER
STRIP
PTA. CRUZ
ENSENADA ORANGETREE BAY
OBSERVER BEACH
ENGLISHMAN BEACH
LONG BEACH
CROSS ROADS
GOAT HILL
MAIN CAMP
PTA. DEL CABO
GARBAGE DUMP
PUMP RAVINE
MAX POINT
PTA. N. SPERO
NAVY COVE
NAVY COVE RD.
SOUTH BEACH
MANGO BEACH
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SAN JOSE
REPUBLIC OF PANAMA
LAT. 8°16' N. LONG. 79°07' W.
ROADS
IMPORTANT TRAILS
SCALE
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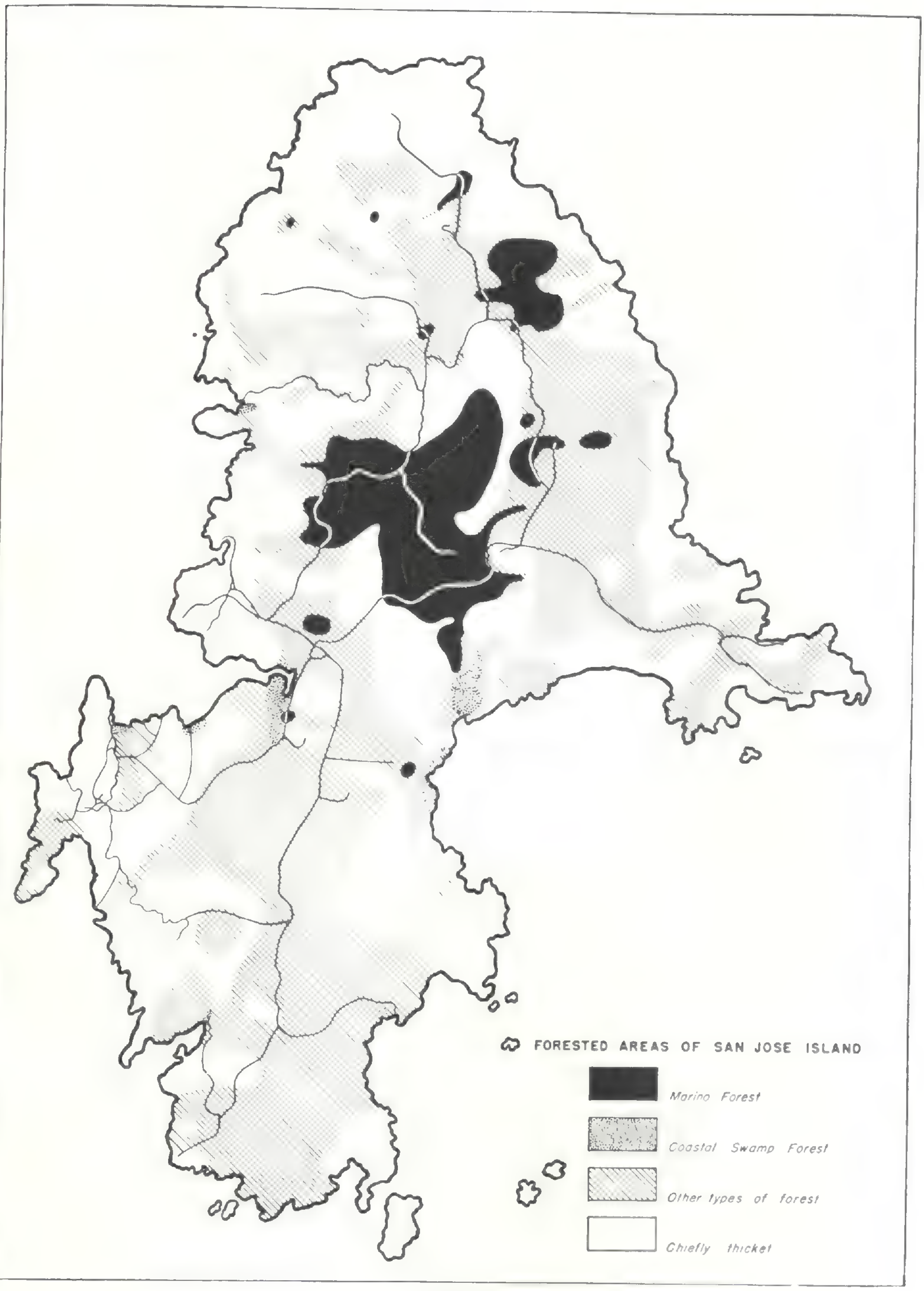
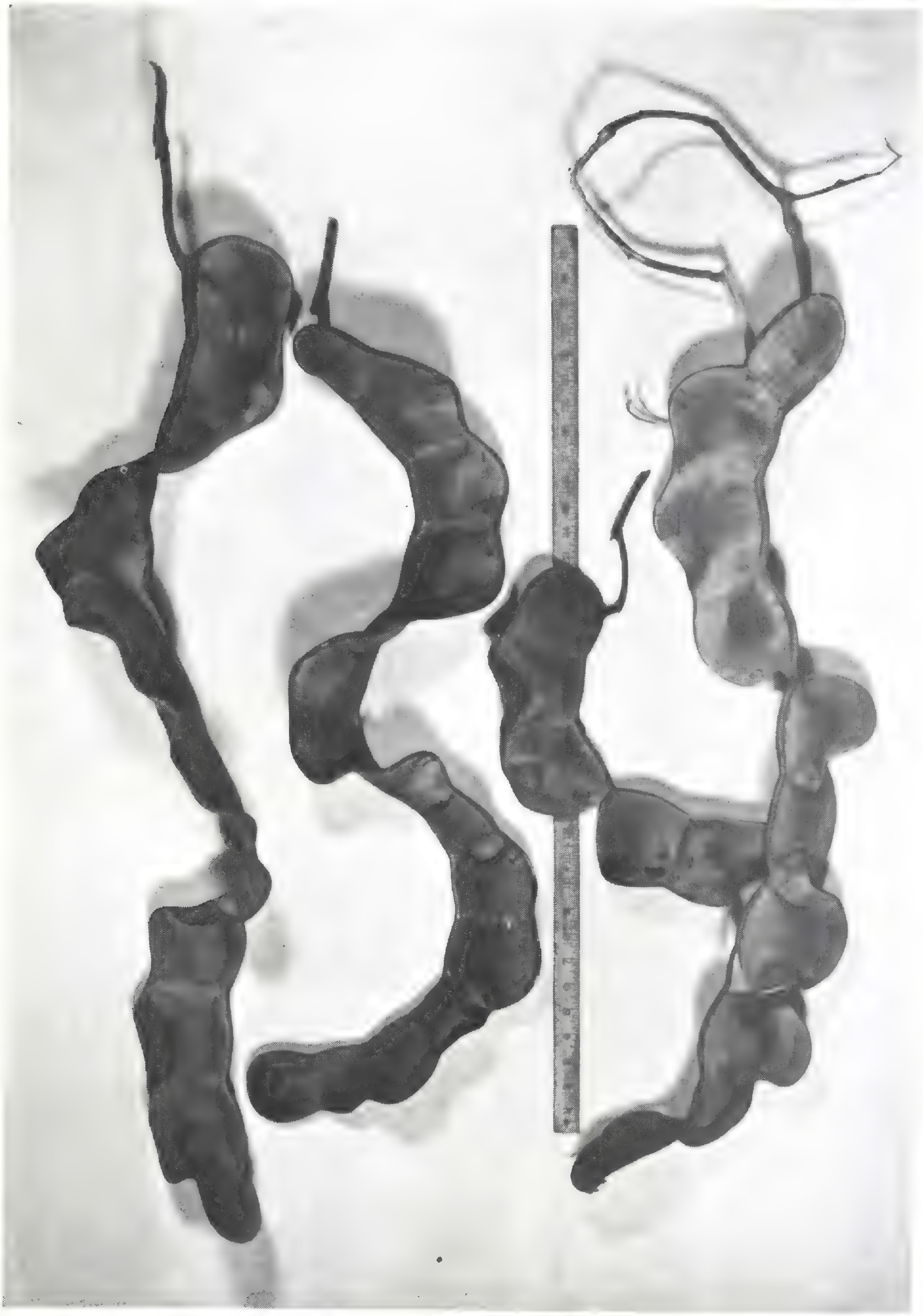

FORESTED AREAS OF SAN JOSE ISLAND
Marino Forest
Coastal Swamp Forest
Other types of forest
Chiefly thicket

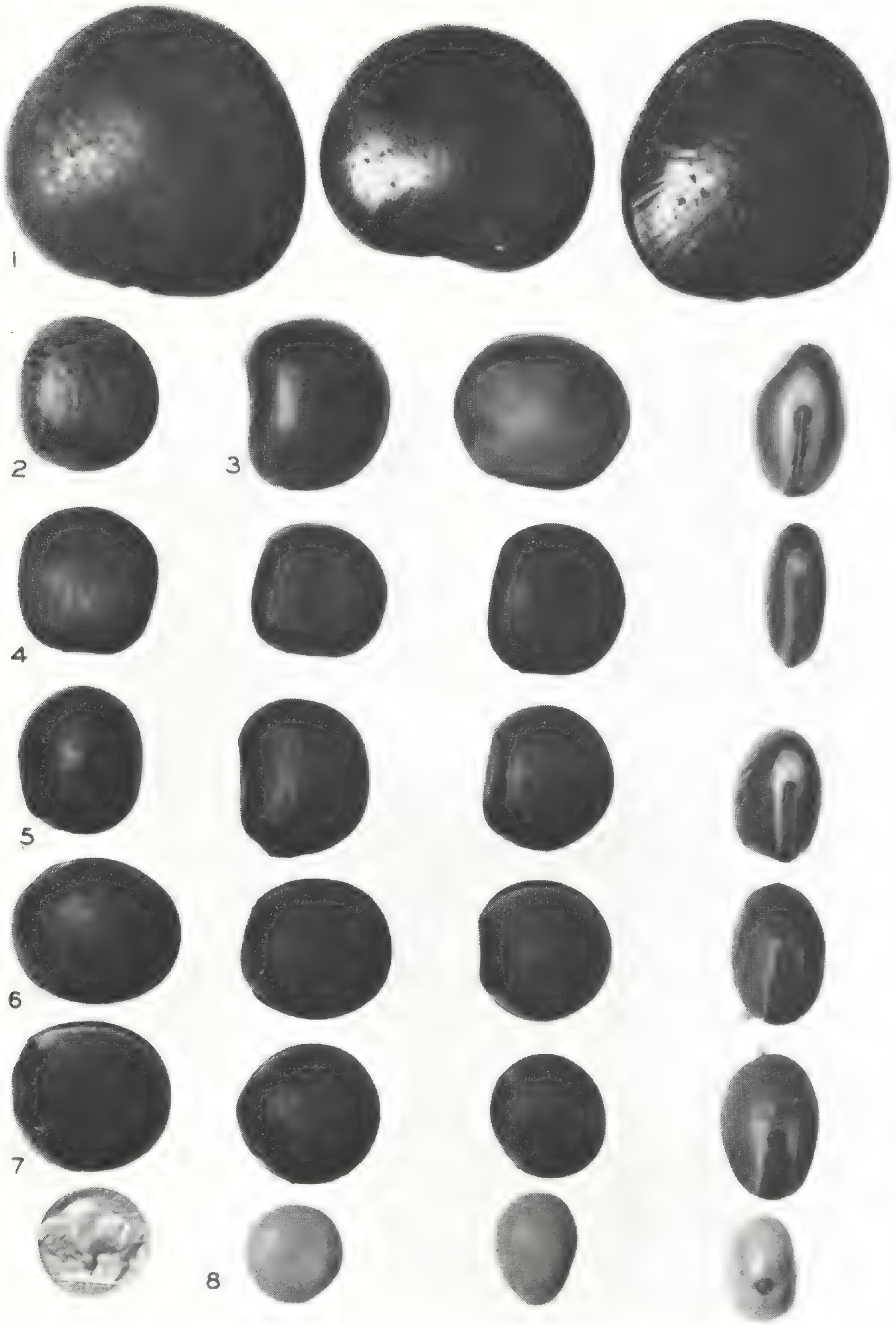
The Botany of San Jose Island

The Botany of San Jose Island

The Botany of San Jose Island

THE BOTANY OF SAN JOSE ISLAND

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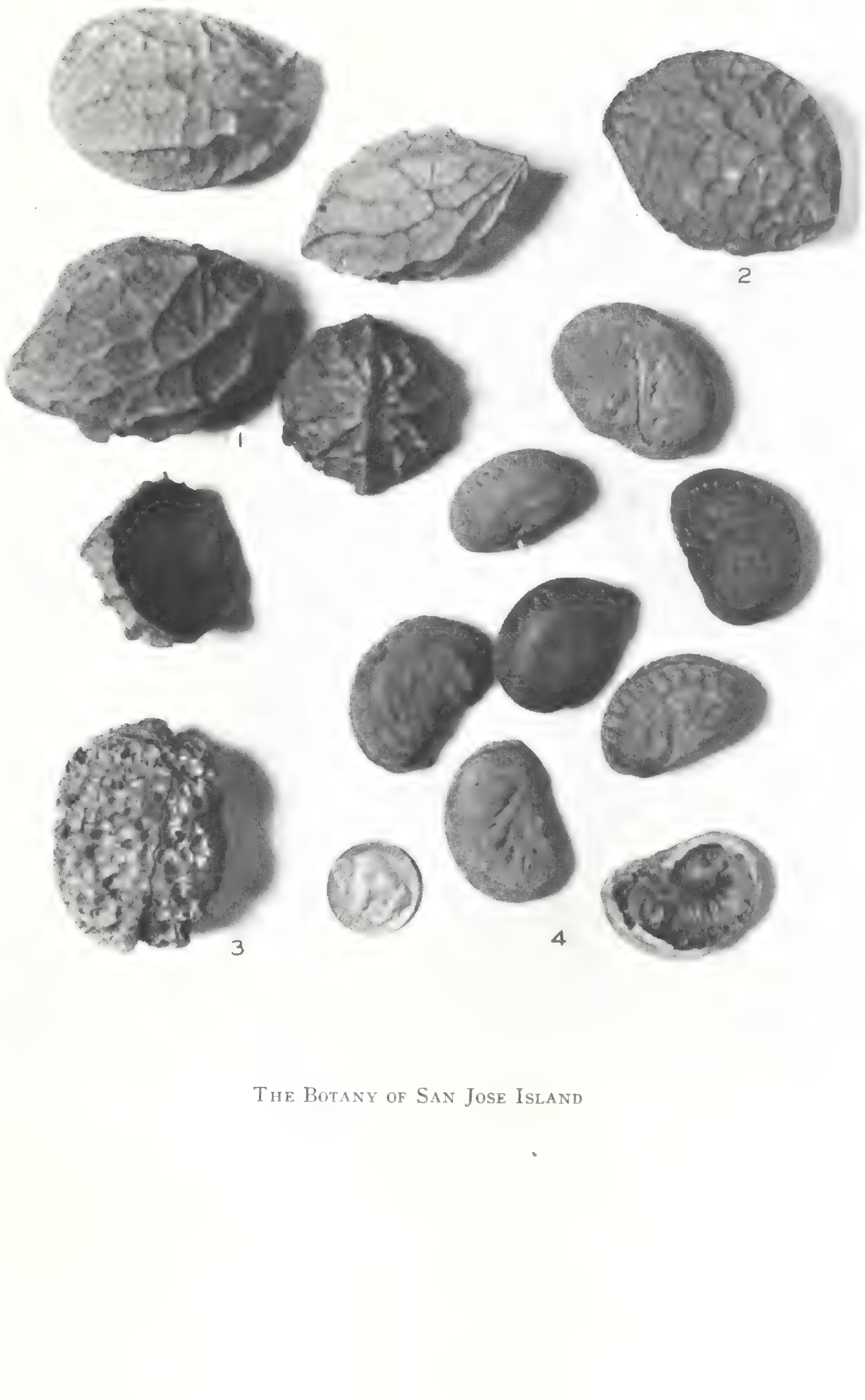
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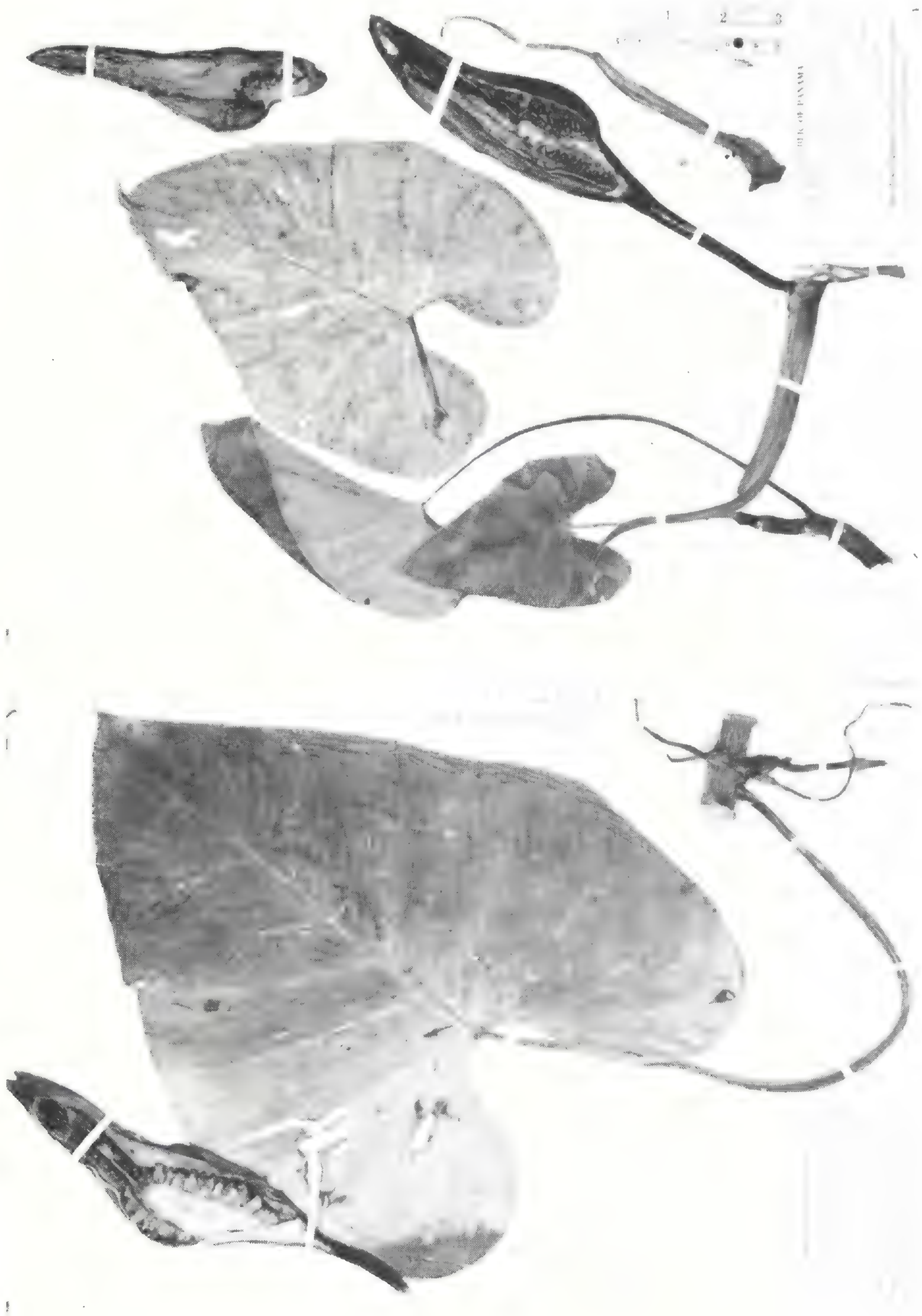

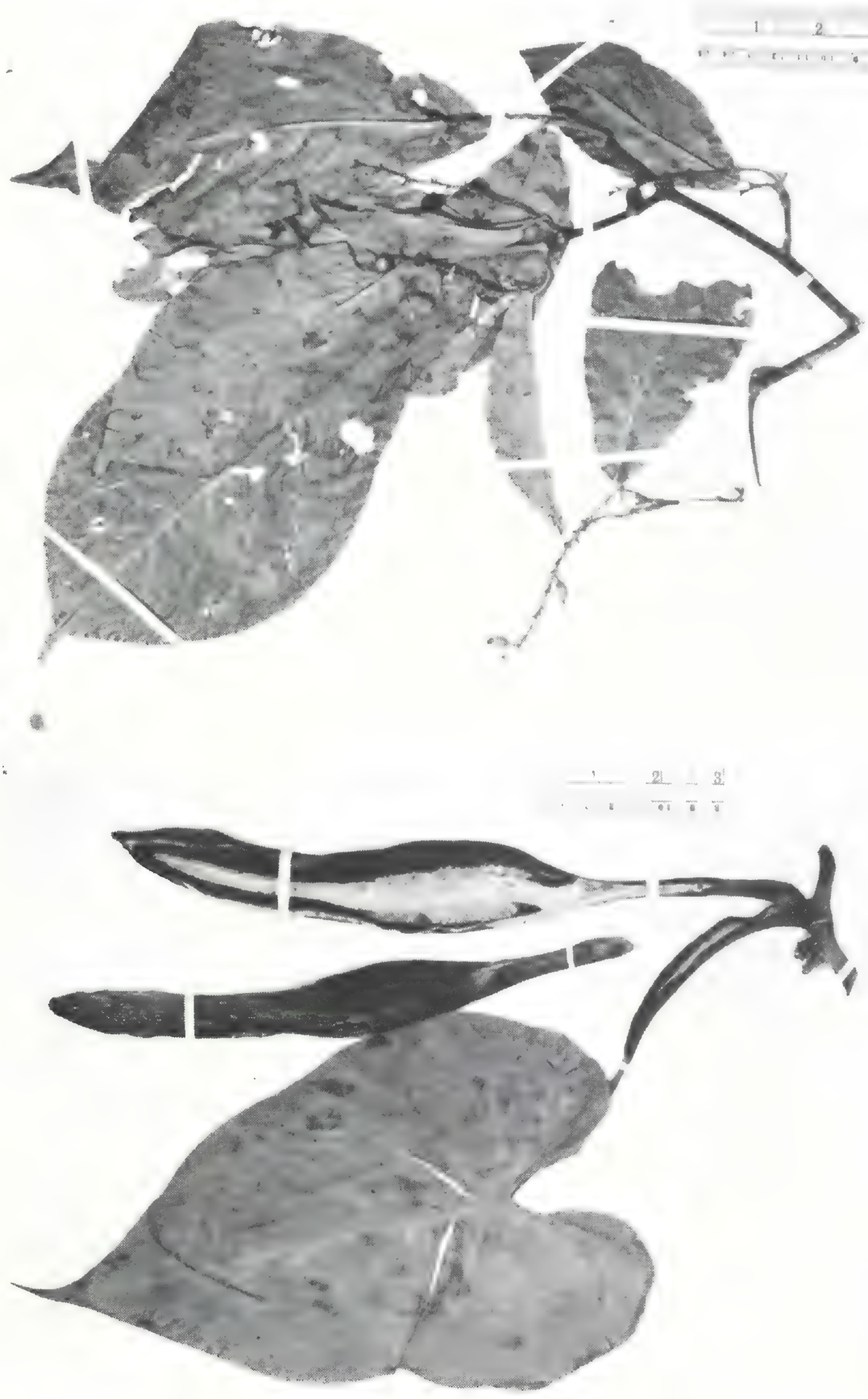

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